SPECIAL REPORT: Cairo, Copland, 64-bit Unix

Dual Pentium Pro Screamers P.112 **Tools to Direct Your Own** Multimedia P.122 Web PC Takes Shape P.105

the global authority for computing technology

EXCLUSIVE

INSIDE SUN'S

TRANSFORM COMPUTING?

PLUS:

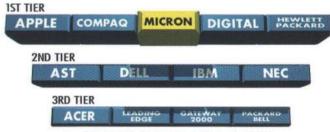
- -ATM to the Desktop
- -PowerBuilder 5 vs. Centura



E HAPPEN TO MAKE THEM.

reliability, you really have to look inside. We focus on superior engineering, from picking t is outstanding performance you can count on. Our first-tier reliability status proves it.





Source: PC World Reliability & Service Monitor, May 20 - November 20, 1995



EDITORS' CHOICE AWARDS MILLENNIA™ P166 & P133

MS WINDOWS® 95 & MS OFFICE INSTALLED













ELECTRONICS, INC.

http://www.mei.micron.com

WHAT A COINCIDENCE, W

To get an idea of how Micron Electronics™ products have achieved leadership status in the best components available to rigorous performance and reliability tests. The result

FAST 12X CD-ROM

200MHz PENTIUM® PROCESSOR

32MB ULTRA-FAST EDO RAM UPGRADABLE TO 128MB

HIGH-SPEED 512KB
PIPELINE BURST CACHE

EIDE OR ULTRA SCSI HARD DRIVE

ACCESSIBLE FULL-LENGTH SLOTS

MASSIVE EXPANSION BAYS

4MB EDO HIGH-RESOLUTION 3D VIDEO ADAPTER W/MPEG

ADVANCED
INTEL 82430HX CHIPSET



16-BIT STEREO
SOUND AND SPEAKERS

TOOL-FREE CHASSIS W/SECURITY FEATURES

LOOKING FOR THE BEST PCS ON THE MARKET?







MILLENNIA™ P166

- Intel 166MHz Pentium® processor
 512KB pipeline burst cache, flash BIOS
- 12X EIDE CD-ROM drive, 3.5" floppy drive
- 16-bit stereo sound & speakers
- PCI 64-bit 3D video, MPEG, 4MB EDO
- Tool-free minitower or desktop
- · Microsoft® Mouse, 104-key keyboard
- Microsoft Windows® 95 & MS® Plus! CD.
- ✓ 5-year/3-year Micron Power^{su} warranty
 - 16MB EDO RAM 1.2GB FIDE hard drive
 - 15" Micron 15FGx. .28dp (13.7" display)
 - · Microsoft Works 95 CD

999 Business lease \$68/month

- 32MB EDO RAM 2.1GB EIDE hard drive
- 15" Micron 15FGx. 28dp (13.7" display)
- Microsoft Office Pro 95 & Bookshelf® 95 CDs

Reciness lease \$78/month

- 64MB EDO RAM 3 168 FIDE hard drive
- 17" Micron 17FGx, .26dp (15.8" display)
- . Microsoft Office Pro 95 & Bookshelf 95 CDs

Business lease \$100/month

- With 133MHz Pentium processor.....subtract S200
- With 200MHz Pentium processor......add \$100

MILLENNIA™ P200 PLUS

- Intel 200MHz Pentium processor
- 512KB pipeline burst cache, flash BIOS
- PCI 32-bit Ultra SCSI Fast-20 controller
- 12X SCSI CD-ROM drive, 3.5" floppy drive
- 16-bit stereo sound & speakers
- · PCI 64-bit 3D video, MPEG, 4MB EDO
- · Tool-free minitower or desktop
- Microsoft Mouse, 104-key keyboard
- · Microsoft Windows 95 & MS Plus! CD
- 16MB EDO RAM 2GB Ultra SCSI hard drive
- 15" Micron 15FGx, .28dp (13.7" display)
- · Mirrosoft Works 95 CD

Business lease \$99/month

- 32MB EDO RAM 2GB Ultra SCSI hard drive
- 15" Micron 15FGx, .28dp (13.7" display)
- Microsoft Office Pro 95 & Bookshelf 95 CDs

Business lease \$105/month

- 64MB EDO RAM 4GB Ultra SCSI hard drive • 17" Micron 17FGx, .26dp (15.8" display)
- . Microsoft Office Pro 95 & Bookshelf 95 CDs

Business lease \$138/month

With 166MHz Pentium processor.....subtract \$100

HOME MPC™ P133

- Intel 133MHz Pentium® processor
 256KB pipeline burst cache, flash BIOS
 16MB EDO RAM 1.2GB EIDE hard drive
- 12X EIDE CD-ROM drive, 3.5" floppy drive
- 16-bit stereo sound & speakers
 28.8 fax/modem, speakerphone, voice mail
 Microsoft® Phone telephony software
- Internet ready: Internet in a Box from CompuServe®/Spry
- Internet in a Box trom Compuserve-/spry Microsoft Internet Explorer
 Prodigy®, America Online® & CompuServe trial memberships
 PCI 64-bit 3D video, MPEG, 2MB EDO
 15" Micron 15FGx, 28dp (13.7" display)
 Tool-free minitower or desktop
 Tool-free minitower or desktop

- · Microsoft Mouse, 104-key keyboard
- Microsoft Windows® 95 & MS® Plus! CD
 Quicken® Financial Pak includes: Quicken Deluxe 5.0; Quicken Financial Planner"; Quicken Parents' Guide to Money"; Quicken Family Lawyer" • Family Pak includes: ABC by Dr. Seuss; Thinkin'
- Things" Collection 1; Earthworm Jim"; and Mechwarrior® 2
- Microsoft Home Pak includes: Works 4.0 for Windows 95; Publisher Deluxe for Windows 95; Encarta® 96; Encarta 96 World Atlas; Music 95; Encarta" 96; Encarta 96 World Altas; Musi Central" 96; Wine Guide; Arcode 1.0; Scenes-Sports Extremes Collection; Gnemonia" 96; Julia Child Home Cooking, Best of Windows Entertainment Pack; CD Sampler (including Fury's game demo)

 5-year/3-year Micron Power's warranty

With 166MHz Pentium processor......

HOME MPC™ P200

- Intel 200MHz Pentium processor
 256KB pipeline burst cache, flash BIOS
 32MB EDO RAM 2.1GB EIDE hard drive
 12X EIDE CD-ROM drive, 3.5" floopy drive
- 16-bit 3D Wavetable stereo sound card
 Advent AV270 2x25 watt stereo speakers
 28.8 fax/modem, speakerphone, voice mail
 Microsoft Phone telephony software

- Internet ready: Internet in a Box from CompuServe®/Spry
- Microsoft Internet Explorer

 Prodigy, America Online & CompuServe

- Microsoft Internet Explorer

 Prodigy, America Online & CompuServe
 trial memberships

 PCI 64-bit 3D video, MPEG, 2MB EDO

 17" Micron 17FGx, 26dp {15.8" display}
 Tool-free minitower or desktop
 Microsoft Mouse, 104-key keyboard
 Microsoft Mindows 95 & MS Plus! CD
 Microsoft Windows 95 & MS Plus! CD
 Microsoft Office Pro 95 & Bookshelf® 95 CDs

 Quicken Financial Planner; Quicken Parents'
 Guide to Money; Quicken Family Lowyer
 Family Pak includes: ABC by Dr. Seuss; Thinkin'
 Things Collection 1; Earthworm Jim; and
 Mechwarrior 2

 Microsoft Home Pak includes: Works 4.0 for
 Windows 95; Publisher Deluxe for Windows
 95; Encarta 96; Encarta 96 World Atles; Music
 Central 96; Wine Guide; Arade 1.0; SenesSports Extremes Collection; Cinemania 96;
 Julia Child Home Cooking; Best of Windows
 Entertainment Pack; CD Sampler (including
 Fury' game demo) Fury³ game demo)

◆ 5-year/3-year Micron Power warranty

• With 166MHz Pentium processor.....

.subtract \$100

MILLENNIA TRANSPORT

- Mobile Intel Pentium processor
 Intel 430MX PCI chipset
 2256B L2 pipeline burst coche
 16MB EDO memory (48MB max.)
 8X modular CD-ROM drive
 PCI graphics accelerator, 1MB EDO memory
 Pick-a-Poini" dual pointing devices integrate
 both pointing stick and touchpad
 Removable EIDE hard drive
 3.5" modular flappy drive
 Intelligent modular lithium-ion battery
 16-bit stereo sound
 Built-in stereo speakers and microphone
 2 Type II or ane Type III PCMCIA stots
 5-video and NTSC-video outputs
 Headphone, microphope and line-in jacks
 2 intrared ports, one front, one back
 Parallel, serial, VGA and 2 PS/2 ports
 Dimensions: 11.7" x 9.4" x 2.0", Weight: 6.9 lbs.t
 Nylon carrying case

- Nylon carrying case
 Microsoft Office Pro 95 and MS® Plus! CD
 Microsoft Office Pro 95 and Bookshelf® 95 CDs
 Kensingland "security lock ready"
 5-year/3-year Micron Power warranty

- † 6.9 lbs. includes 3.5" flagpy and one battery
 †† Lock secures both Millennia TransPort and MicronDock***
- **OPTIONS** With 150MHz Pentium processor add \$200 With Motorola Montana 28.8 fax/modem. ..add \$259 • With 3Com® Ethernet 10BT PCMCIA add \$149 With Samsonite® leather carrying case
 With 2nd modular lithium-ion battery. 599 .add \$199 • With 2nd hard drive (2.1GB) add \$699 With 16MB DIMM module upgrade
 With 32MB DIMM module upgrade ..add \$349 ..add \$749 MicronDock™ multimedia port replicator add \$299 MicronExec™ desktop package

- 133MHz Intel Mobile Pentium processor
- 16MB EDO memory (48MB max.)
- 12.1" active matrix display, 800 x 600
- 1.2GB removable hard drive \$4,399 Business lease \$150/month

- 133MHz Intel Mobile Pentium processor
- 32MB EDO memory (48MB max.)
 Motorola® Montana 28.8 fax/mode
- 12.1" active matrix color display, 800 x 600
- 1.2GB removable hard drive
- · 2nd lithium-ion battery

Business lease \$163/month

- 150MHz Intel Mobile Pentium processor
- 32MB EDO memory (48MB max.)
- 12.1" active matrix color display, 800 x 600
- 2.1GB removable hard drive • Motorola® Montana 28.8 fax/modem
- 2nd lithium-ion battery
 Samsonite® leather carrying case

Business lease \$174/month



add \$799 900 E. Karcher Road, Mampa, 10 83687 * Man-Fri Gam-Turn Set 7 am-Sum (MT) * International Sales Hous: Man-Fri Gam-Turn (MT) * 208-893-3434 * Fax 208-893-3424

Purchase Order Fax 208-893-8992.
 Tachnical Support Available 24 Hours /7 Days = Technical Support E-mail: techsupport.meix@micron.com









C1996 Micron Electronics, Inc. All rights reserved. Micron Electronics is not responsible for omissions and/or enors in typography or photography. All purchases are subject to availability. Prices and specifications may be changed without notice, prices do not include shipping and handing. 30-say money-back popils does not include shipping and handing. 30-say money-back popils does not include intrust meight and original shipping-handing charges, applies only to Micron Electronics current terms and conditions of sale. Lease prices based on 95-month sease. Intit, Intel Inside and Pentium are registered trademarks of the Intel Corporation. Microsoft. Windows Windows NT and the Windows logo are registered trademarks of Microsoft Corporation. All other service marks, Indomarks and registered trademarks and registered trademarks are the property of their respective companies.

BYTE-PAN-9611

MILLENNIA™ Pro2 200 MILLENNIA™ PRO2 400 PLUS

- Intel 200MHz Pentium® Pro processor
- Supports dual 200Mhz Pentium Pro processors
- 256KB internal cache, flash BIOS
- 12X EIDE CD-ROM drive, 3.5" floppy drive
- 16-bit stereo sound & speakers
- o PCI 64-bit 3D video, MPEG, 4MB EDO Tool-free minitower or desktop
- · Microsoft® Mouse, 104-key keyboard
- Microsoft Windows NT[®] Workstation 4.0 CD
- 16MB EDO RAM 1.2GB EIDE hard drive
- 15" Micron 15FGx, .28dp (13.7" display)

· Microsoft Works 95 CD

Rusinass lance \$78/month

- 32MB EDO RAM 2.1GB FIDE hard drive
- 17" Micron 17FGx, .26dp (15.8" display) Microsoft Office Pro 95 & Bookshelf
 95 CDs

Business lease \$97/month

With 2nd 200MHz Pentium Pro processor...add \$699





• Dual Intel 200MHz Pentium Pro processors

- 256KB internal cache, flash BIOS • PCI 32-bit Ultra SCSI Fast-20 controller
- . 12X SCSI CD-ROM drive, 3.5" floppy drive
- 16-bit stereo sound & speakers PCI 64-bit 3D video, MPEG, 4MB EDO
- Tool-free mini-tower or desktop
- · Microsoft Mouse, 104-key keyboard
- Microsoft Windows NT Workstation 4.0 CD · Microsoft Office Pro 95 & Bookshelf 95 CDs
- ✓ 5-year/3-year Micron Power warranty
- 32MB EDO RAM 2GB Ultra SCSI hard drive
- 15" Micron 15FGx, .28dp (13.7" display)

Rusiness leave \$136/month

- 64MB EDO RAM 4GB Ultra SCSI hard drive
- 17" Micron 17FGx, .26dp (15.8" display)

• 128MB EDO RAM • 9GB Fast SCSI-2 hard drive • 21" Micron 21FGx, .26dp (20.0" display)

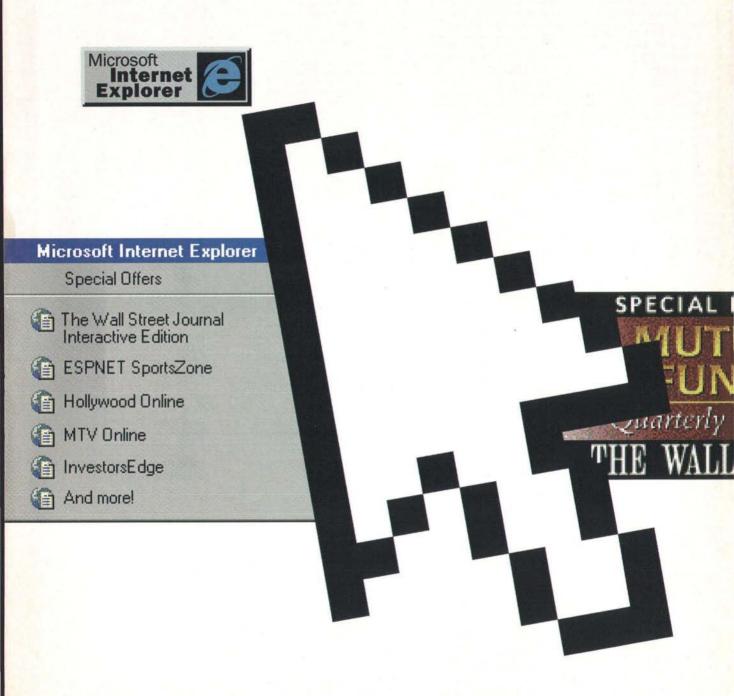
Business lease \$226/month

Business lease \$168/month

ELECTRONICS, INC.

800-362-730 http://www.mei.micron.com

Microsoft Internet Explorer 3.0



©1996 Microsoft Corporation. All rights reserved. Microsoft is a registered trademark and the Microsoft Internet Explorer logo and Where do you want to go today? are trademarks of Microsoft Corporation. The Wall Street Journal® Interactive Edition is a trademark of Dow Jones & Company, Inc. ESPNET is a trademark of ESPN, Inc. SportsZone is a trademark of Starwave Corp. MTV is a trademark of MTV Networks, a division of Viacom International, Inc. Hollywood Online is a trademark of Hollywood Online is a trademark of Hollywood Online Inc. InvestorsEdge ©1995 Ethos Corp.

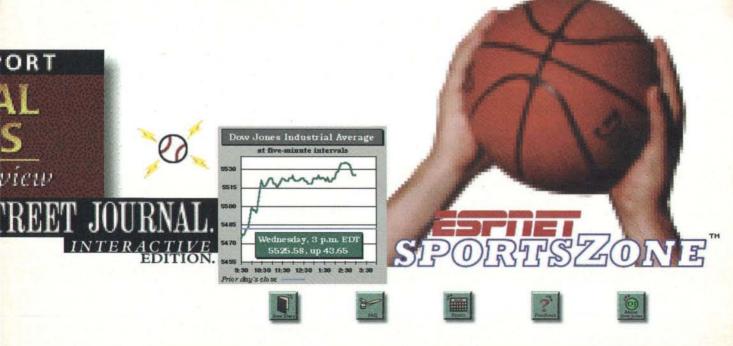
^{*}Connect time charges may apply to all offers.

IS YOURS TO DOWNLOAD, ABSOLUTELY free, COMPLETE WITH SUBSCRIPTIONS

TO THE WALL STREET JOURNAL INTERACTIVE

EDITION AND ESPNET SPORTSZONE,

also free.



Introducing Microsoft® Internet Explorer 3.0. The new browser that's a step ahead of all the rest. It lets you experience all the coolest content, like sound and animation, that's being developed for the Internet today. It lets you customize the way you access and view the web. And it's yours to download right now, absolutely free.* From now through December 31, we have all kinds of special offers that make the experience even better: You get The Wall Street Journal® Interactive Edition, free. It's the web's leading source of business news, with 24-hour updated coverage of world business and deep background on thousands of companies and

topics. You also get a free subscription to the premium areas of ESPNET" SportsZone," the number one destination site on the web, including expert columnists, multimedia highlights, behind-the-scenes reports, in-depth player profiles, and more. Our new browser also gives you free access to "buy, sell, hold" stock recommendations from InvestorsEdge, the Internet's premier financial information service. And there's even special content on MTV" Online and offers on other sites that can only be seen with it. Just go to www.microsoft.com/ie. Then click one button. And see what a real browser can bring you these days.

Microsoft

BYTE

November 1996, vol. 21, no. 11



EDITORIAL

you'll face in the next year.

Computing Crossroads

14

By Mark Schlack
Sun's Java chip/Java language
combination is the most radical
bid for a new computing
platform in years.

INBOX

19

BYTE readers write about our Web coverage, NT security, the on-line future, and more.

BITS

The Return of Hand-Held		Java Forms	38
Windows	26		
		Future Notebook Screens	42
Web Info Delivery	27		13
Cyrix 6x86 Bug	30		
Post-Millennium Cruising	30	THE PROPERTY OF THE PARTY OF TH	
Plugged-In CD-ROMs	32		
122 SEED TO DO		New PowerPCs	44
FlashPix Graphics	36		

Flying Robots

Inside the NC

105

By Peter Wayner
Are network computer

Are network computers just strippeddown terminals? Not hardly.



Keep Networks Safe from Viruses

167

By Barry Nance

Networks put you at risk from viruses; an enterprise-wide strategy can help keep you safe.

SPECIAL REPORT

Your Next OS

48

134

By Dick Pountain
Six key issues to consider.

Unix Leads the 64-bit Charge

139

By Laurent Lachal
64-bit OSes are moving from
the horizon to the desktop.

Unearthing Cairo

145

By Mark Minasi
Follow the signs to Cairo to get
a glimpse of NT's future.

Copland, Revisited

151

By Tom Thompson
A look at the current state of
Apple's next OS.

Survey: Web Commerce

By Tom Thompson Digital Harbor's WAV word processor is among the first OpenDoc components for the Macintosh.

Waterproof Color That Lasts

By Robert L. Hummel The Alps MD-4000 prints smudge-proof color images and razor-sharp text. It's also a 600-dpi color scanner.

GroupWise Sends a Message

By Steve Gillmor Novell's Release 5 makes the choice of groupware a tougher decision.



Hybrid Web/CD-ROM: Do It Yourself

54

By Ion Udell What bandwidth problem? WebCD lets you publish your Web site on CD-ROMs that retain live Internet links.

LAB REPORT

LAB REPORT: HARDWARE



Eight Twin-Engine Pentium Pro Workstations

By Maggi Bender, Dorothy Hudson, Jim Kane,

WEB PROJECT

On-Line Componentware

Here's how you can turn your

ware component to build new

COMPARISON

Evaluating new versions of two

Builder (the program formerly

client/server toolkits: Power-

Builder and Centura Team

known as SQLWindows).

Web site into a flexible soft-

applications quickly.

Upgraded C/S Tools:

How Much Better?

By Mark Hettler

By Ion Udell

and John McDonough Our tests point out the peak performers and the best buys.

LAB REPORT: SOFTWARE

How Multimedia Multitools Compare

By David Seachrist NSTL tests four authoring programs for building mixedmedia applications.

REVIEWS

Real-Time RAD

By Rick Grehan Verilog's ObjectGeode does a decent job of marrying realtime control to OO-modeling standards.

Ditto Your Data

By Robert L. Hummel Iomega's Ditto 2GB External drive delivers everything you expect from a portable backup unit: convenience, low cost, ease of use ... and sluggish performance.



CORE

OPERATING SYSTEMS

VMS: Alive and Well

By Ben Smith A young horse is fast, but an old horse knows what's going on.

NETWORKS

A File System for the Web

By Bob Friesenhahn A modified version of Sun's NFS can deal with large amounts of Web data.

CPUs

The Consumer PowerPC Revisited

By Tom Thompson Motorola's slimmed-down PowerPC could be the brains of your next hand-held PC.

PROGRAMMING

Parallel Processing in Bulk

By Dick Pountain A new programming model offers hope for solving problems of complexity.

184

CHAOS MANOR

Don't Swap-Network!

185

By Jerry Pournelle Jerry offers advice on upgrading and engages in another struggle over IRQ assignments, this time under Windows 3.11.

WHAT'S NEW

240

Fractal Design's Expression goes beyond standard vectordrawing packages; Gateway's Solo 2100 S5-120 combines raw power and good looks.



CODE TALK

Visual Age for BASIC...Sort of

By Rick Grehan

Visual Age for BASIC has more in common with Visual Basic than with the other Visual Age products.

SERVICE

Reader Service

Inquiry Reply Cards 104A-B. 232A-B

Index To Advertisers

Alphabetical Order 232 **Product Category** 234 Editorial Index by Company 236

PROGRAM LISTINGS

FTP: ftp.byte.com From BIX: Join "listings/ frombyte96" and select the appropriate subarea (i.e., "nov96").

THE BYTE WEB SITE and THE VIRTUAL PRESS ROOM

http://www.byte.com

BYTE (ISSN0380-5280) is published monthly by The McGraw-Hill Companies, Inc. U.S. subscriber rate \$29.95 per year. In Canada and Mexico, \$34.95 per year. European surface mail subscriptions \$60, airmail \$85. Non-European subscriptions, \$60 surface mail or \$85 airmail. All foreign subscriptions are payable in U.S. funds that can be drawn on a U.S. bank. Single copies \$3.95 in the U.S., \$4.95 in Canada. Executive, Editorial, Circulation, and Advertising Offices: One Phoenix Mill Lane, Peterborough, NH 03458. Periodicals postage paid af Pethorough, NH, and additional mailing offices. Postage paid at Winnipeg, Manitoba. Canada Post International Publications Mail Product Sales Agreement No. 246492. Registered for GST as The McGraw-Hill Companies, Inc., GST #123075673. Postmaster: Send address changes and fillilliment questions to BYTE Send address changes and fillilliment questions to BYTE. Send address changes and fulfillment questions to BYTE Subscriptions, P.O. Box 552, Hightstown, NJ 08520. Printed in the United States of America.

CONTENTS BY PLATFORM

INDEX

WINDOWS	OS/2	Real-Time RAD 181	AltaVista 129
Windows for Tiny PCs 26	Keep Networks Safe	Verilog's ObjectGeode com-	Backup 184
CE will bring some Win 95	from Viruses 167	plies with OO standards, but	Cairo 145
capabilities to hand-held PCs,	DOS-based viruses running on	code generation is another	CD-ROM 32, 44, 54, 185
PDAs, pagers, and cell phones.	OS/2 and viruses designed to infect native OS/2 executables	thing, our reviewer discovers.	Chips 67, 76, 79, 89, 101
GroupWise Sends	can create havoc.	NETWORKS	Client/server 177
a Message	MACINTOSH	Eight Twin-Engine Pentium Pro Workstations 112	Componentware 49, 129
how's it compare to Microsoft	New PowerPCs	Some of these speed demons	Copland 151
Exchange and Lotus Notes?	Boost Macs	are designed to serve networks.	Databases 139
The x86 Gets Faster	BYTE benchmarks show that the latest PowerPC-based	Your Next OS 133	Data synchronization 71
with Age 89	Macs offer a performance jolt.	We take a network's-eye view	Embedded systems 67,79
While Intel enhances the Pen-	The state of the s	of the next generation of oper-	Enhanced IDE 112
tium, chip competitors will	Componentized WAV	ating systems.	Groupware 53
introduce new x86-compatible CPUs in the coming year.	of the Future	Keep Networks Safe	Company of the Company of the Company
Cros in the conning year.	processor shows off Open-	from Viruses 167	HTML
Eight Twin-Engine Pentium	Doc's potential.	Sharing files on servers and	HTTP 63, 105
Pro Workstations 112	W. 1	connecting to the Internet pre-	Internet 26,27,36,129
A 200-MHz Pentium Pro pro- vides great Windows NT per-	Waterproof Color That Lasts 50	sent more entry points than ever for viruses.	Java 14,38,79,105
formance. Two Pentium Pros	The Alps MD-4000 resin-ther-	ever for viruses.	Mobile devices 26,43,67
are even better.	mal-transfer printer produces	Upgraded C/S Tools:	Multimedia 122
H M. M. W. P. M. R.	high-quality color images.	How Much Better? 177	Multiprocessing 134, 145, 151
How Multimedia Multitools Compare	The Consumer PowerPC	PowerBuilder goes up against Centura Team Builder in this	Networking 63, 134,
A review of four Windows 95-	Revisited 67	comparison of client/server	139, 145, 167
based authoring kits for build-	Motorola's new embedded	development packages.	Network Computers 105
ing multimedia projects.	processor uses a PowerPC core.	INTERNET	00P 181
Your Next OS 134	PowerPC Regroups 101	Web Info the Way	OpenDoc
Points to consider when	The chips will shatter the	You Want It27	Operating systems . 59, 134,
comparing Windows with	300-MHz barrier soon.	On-line Ginsu knives cut	139, 145, 151
other operating systems.	Control Projected 151	through the jive to carve out	Parallel processing 71
Unearthing Cairo 145	Copland, Revisited 151 Apple's next-generation OS	what you're searching for.	PCs, dual-CPU 112
Bits of Microsoft's ambitious	promises better performance	CD-ROM Weds the Web .32	
project will show up in future	and new features.	A new trend in optical storage:	PowerPC 44, 67, 101
versions of Windows NT.	UNIX	CDs with links to Web sites.	Programming 71, 122, 129, 177, 181, 248
Don't Swap—Network! . 185	VMS: Alive and Well 59	Web-Commerce	
Upgrading a CD-ROM under	An update on the OS that's	Polarization	Printers 50
Win 3.11 results in another	probably Unix's closest rival.	Results from the latest BYTE	Real-time applications . 181
IRQ struggle at Chaos Manor.	United and the	Survey on Internet commerce	Robots
What's New 240	Unix Leads the 64-bit Charge 139	and privacy. Cookies, anyone?	SCSI
Fractal Design's Expression	While those younger OSes are	Sun Gambles on Java Chips 79	Storage, portable 184
software brings natural media	hanging out in 32-bitland,	We describe the architecture	Universal Serial Bus 112
to vector drawing.	Unix moves on.	and the technical implications of these radical new processors.	Unix 59, 134, 139
Visual Age for BASIC	Keep Networks Safe	or these ratheat new processors.	Viruses 167
Sort of 248	from Viruses 167	Inside the NC 105	Word processing 49
In Codetalk, Rick Grehan	The network structure of Unix	Just what is a Network Com-	World Wide Web 27,54,
looks at IBM's construction kit and discovers where Visual	machines connected to the Internet means the door's	puter? Peter Wayner explains why NCs are much more than	63, 122, 129
Basic meets OOP.	open for some viruses.	dumb terminals.	x86 30,89,112
	The second secon		

And the WINNER is...

Pinnacle Micro's

2.6 GB Optical
Storage System



- ✓ Best Overall Removable Media Drive
- **✓** Best High Performance
- ✓ Best Low Cost

Pinnacle's award-winning 2.6 GB Removable Optical Drive

is only \$1695 (MSRP) complete with one optical disk. Based on Pinnacle's unique optical technology, the Vertex™ boasts a 19 msec seek time, a maximum data rate up to 4.3 Megabytes per second, and a fast rotation speed of 3755 RPM. Vertex utilizes removable, high capacity optical media for unlimited storage. Fill up a disk, just pop in another. Data intensive applications such as imaging, networking, digital video/audio, graphics, and data archiving all require the optimum level of data integrity, portability, and fast random access to your information. Vertex can hold up to 2.6 Gigabytes of mass storage on a single cartridge that complies with industry standards for data interchangeability with other 2.6 GB optical drives. Each removable disk is only ¹119 (MSRP) and has an estimated shelf life up to 100 years! And now, Vertex-based optical library systems are available in capacities ranging from 40 Gigabytes to 2.5 Terabytes for on-line centralized storage in network environments. Go with the

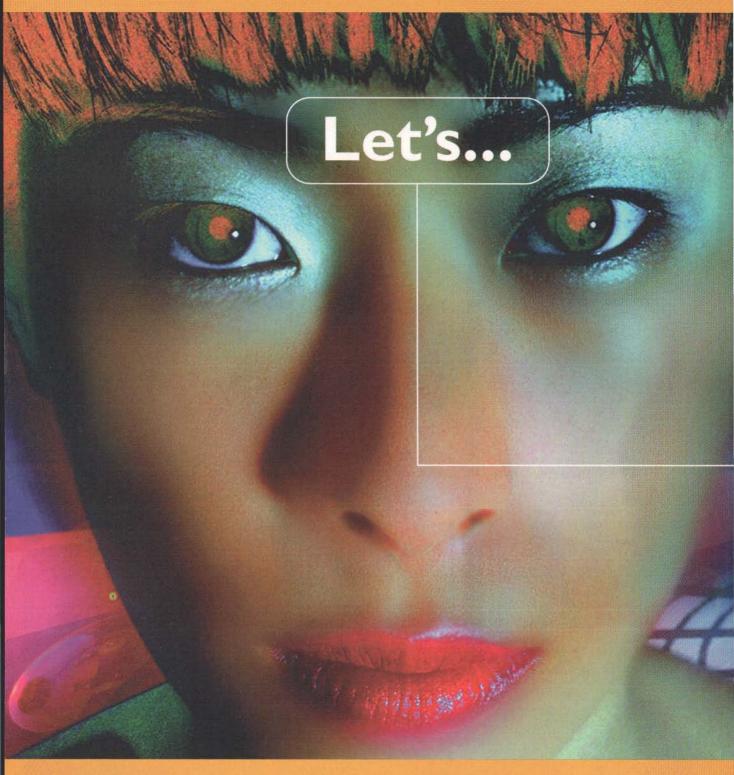
800-553-7070

winning removable storage drive from Pinnacle Micro, the optical storage leader.

The Pinnacle Micro logo is a registered trademark of Pinnacle Micro Inc.
All other trademarks are trademarks of their respective owners.



Tel: 714-789-3000 • Fax: 714-789-3150 • http://www.pinnaclemicro.com Circle 155 on Inquiry Card (RESELLERS: 156).





Who's putting tomorrow together?

People with vision, who can look at a PC and see the future there. People who imagine group video communication, interactive television, 3D virtual environments, and more - a world of new possibilities in a single package. People whose minds are alive to the potential of multimedia. If that's the race your imagination's running, we're right alongside you. Setting the pace

with a complete range of digital audio, video and graphics solutions to help keep you ahead. With our new TriMedia processor for high end programmable media processing. And dedicated chipsets for applications like desk-top video, video conferencing and games, ready to build into your motherboard. And with innovations in bus, peripheral and interface technologies, supporting common standards like PCI and USB.



With the latest graphics technology that makes high realism 3D possible - and affordable, including leading edge videographics controllers, CD-ROM-based technologies, imaging and display. Run with them and who knows how far your imagination can take you. So see the future today at www.semiconductors.philips.com. Because together we can make tomorrow's multimedia come alive.

Let's make things better.



PHILIPS

Or visit us at: Comdex, L2625 or Electronica, Hall 24, B4

Circle 760 on Inquiry Card.



EDITOR IN CHIEF Mark Schlack

Editor in Chief's Assistant: Linda Higgins

EXECUTIVE EDITORS International-Rich Friedman New Media: Jon Udell

MANAGING EDITOR Jenny Donelan

NEWS

Peterborough: News Editors: David L. Andrews, Martha Hicks Frankfurt:

Senior Editor: Rainer Mauth

REVIEWS

Director of Reviews: David Essex Senior Technical Editors: Rick Grehan, Dave Rowell Technical Editor: Russell Kay

FEATURES

Senior Editor/Features: Alan Joch Peterborough: Senior Technical Editor at Large: Tom Thompson San Mateo: Senior Editor: Tom Halfhill Lexington: Senior Editor: Edmund X. DeJesus

NEW MEDIA Production Associate: Joy-Lyn S. Blake

SENIOR RESEARCHER Rowland Aertker

ASSOCIATE TECHNICAL EDITORS Dennis Barker, Cathy Kingery, Warren Williamson

SENIOR CONTRIBUTING EDITOR Jerry Pournelle

CONTRIBUTING EDITORS Dick Pountain, Udo Flohr, Mark LaPedus

CONSULTING EDITORS Stephen Apiki, Nicholas Baran, Raymond GA Côté, Trevor Marshall, Stan Miastkowski, Barry Nance, Roberta Pournelle, Ellen Ullman, Peter Wayner

EDITORIAL ASSISTANT June Sheldon

DESIGN

Design Director: Charles Dixon III Associate Design Director/Design & Photography: Sharon Price Associate Design Director/Graphics: Joseph A. Gallagher Designers: Barbara Busenbark, Cindy Sands, Donna Sweeney

FINANCE AND OPERATIONS

Vice President: Claudia Flowers

ADVERTISING PRODUCTION Advertising Production Manager: Linda Fluhr Senior Advertising Services Representative: Dale J. Christensen Senior Advertising Production Coordinator: Lyda Clark Advertising Production Coordinators: Karen Cilley, Rod Holden Senior Operations Coordinator: Lisa Jo Steiner Advertising Graphics Manager: Susan Kingsbury Graphics Production Coordinator: Christa Patterson

FINANCE

Senior Financial Analyst: Kathleen Deguise Systems Administrator: Peggy Dunham Junior Financial Analyst: Diane Henry

CIRCUI ATION

Director: Susan Blattman International Circulation Manager: Barbara Copcutt Subscriptions Manager: Lynn Lagasse Assistant Subscriptions Manager: Christine Tourgee Subscription Source Specialist: Carol Sanchioni Newsstand Manager: Vicki Weston Assistant Manager: Karen Desroches Circulation Assistant: Jill Wood

ADMINISTRATION

Human Resources Administrator: Pat Burke Receptionist: Agnes Perry

MARKETING AND PLANNING

Market Information Manager: **Edward Fielding** Market Information Coordinator: Dylan DiGregorio Marketing Services Administrator: Meredith Bickford

VICE PRESIDENT/PUBLISHER John M. Griffin

Publisher's Assistant: Donna Nordlund

ADVERTISING SALES

Sales Assistant: Susan Monkton (603) 924-2635

NEW ENGLAND John Ferraro (617) 860-6221. (212) 512-2555 Jeanne Beeson (617) 860-6349

Michael Feinberg (212) 512-4811 Jill Pollak (212) 512-3585

MID-ATLANTIC/SOUTHEAST Neil Helms (770) 242-6298 Paul Franchak (614) 899-4912

CENTRAL IIS Lori Silverstein (614) 899-4908 Paul Franchak (614) 899-4912

SOUTHWEST Bert Panganiban (214) 688-5165 Brian Higgins (603) 924-2596

SOUTH PACIFIC Beth Dudas (714) 753-8140 Geanette Perez (714) 753-8140

NORTH PACIFIC Roy J. Kops (415) 513-6861 Lisa Farrell (415) 513-6862

INSIDE ADVERTISING SALES Assistant: Vivian Bernier (603) 924-2521

BYTE DECK Brian Higgins (603) 924-2596

EURO-DECK Mark Stone (603) 924-2533

REPRINT SALES Susan Monkton (603) 924-2618

INTERNATIONAL ADVERTISING SALES STAFF Director: L. Bradley Browne (603) 924-2501 Administrative Assistant: Arja Neukam (603) 924-2636 Copyrights Manager:

Faith A. Ellington (603) 924-2525 See listing on page 233.

HOW TO CONTACT THE EDITORS

We welcome your questions, comments, complaints,

kudos, and submissions.
MAIN OFFICE: One Phoenix Mill Lane, Peterborough,

MAIN OFFICE: One Fridents will tane, receivorough, NH 03458, [603] 924–9281.

San Mateo: 1900 O'Farrell St. #200, San Mateo, CA 94403, [415] 513–6912.
Lexington: 24 Hartwell Ave., Lexington, MA 02173, [617] 863–5100.

GERMANY/EUROPE: Emil von Behring Strasse 2, 60439 Frankfurt, Germany, +49 69 5801 123.
ELECTRONIC MAIL: On BIX, send to "editors." All BYTE editors and columnists also have individual mailboxes on BIX

ror easy access.

MCI: 250-0135 BYTE Magazine. Many editors also have individual MCI addresses in their own names.

OTHERS: Many editors also are reachable through uunet, AppleLink, CompuServe, and numerous other services.

WEB: http://www.byte.com U.S. fax: Editorial: (603) 924–2550 Advertising: (603) 924–7507 U.K. fax: +44171 495 6734

SUBMISSIONS:

Authors: We welcome article proposals and submissions. Unacceptable manuscripts will be returned if accompanied by sufficient return postage. Not responsible for

lost manuscripts or photos. Vendors: We welcome news of your new products; please call the News department or the Reviews department at the earliest possible date. We cannot be responsible for unsolicited product samples.

ARTICLE REPRINTS: For price quotations on customized reprints of BYTE articles, contact Susan Monkton, reprints manager, at (603) 924–2618. (Minimum quantity: 500.)

SUBSCRIPTION CUSTOMER SERVICE

Inside U.S. (800) 232-BYTE; autside U.S. +609 426 7676. E-mail-based customer service: mpc-stsvc@mcgraw-hill.com, Web-based customer service: http://www.byte.com/admin/mpaddchg.htm. International subscribers may also contact our inter-

national customer service facility in Galway, Ireland, by calling +353 91 752792 or via fax: +353 91 752 793. For a new subscription, (800) 257-9402 U.S. only, E-mail: mporders@megraw-hill.com or write to BYTE subscription Dept., P.O. Box 555, Hightstown, NJ 08520. Subscriptions are \$29.95 for one year, \$54.95 for two years, and \$74.95 for three years in the U.S. and its pos-sessions. In Canada and Mexico, \$34.95 for one year, \$64.95 for two years, \$87.95 for three years. Internationally, US\$60.00 for fast surface delivery, US\$85.00 for air delivery. Single copy price is \$3.95 in the U.S. and its possessions, \$4.95 in Canada. Foreign subscriptions and sales should be remitted in U.S. funds drawn on a U.S. bank. Please allow six to eight weeks for delivery of first issue

PHOTOCOPY PERMISSION:

Where necessary, permission is granted by the copyright owner for those registered with the Copyright Clearance Center (CCC), 222 Rosewood Dr., Danvers, MA 01923, to photocopy any article herein for personal or internal reference use only for the flat fee of \$1.50 per copy of the article or any part thereof. Correspondence and payment should be sent directly to the CCC, 222 Rosewood Dr., Danvers, MA 01923. Specify ISSN 0360-5280, \$1.50. Copying done for other than personal or internal refer-ence use without the permission of The McGraw-Hill Companies, Inc., is prohibited. Requests for special per-mission or bulk orders should be addressed to Faith Ellington, copyrights manager, (603) 924–2525. BYTE is available in microform from University Microfilms International, 300 North Zeeb Rd, Dept. PR, Ann Arbor, MI 48106 or 18 Bedford Row, Dept. PR, London, WC1R 4EJ,

Copyright \$ 1996 by The McGraw-Hill Companies, Inc.

A Division of The McGraw-Hill Companies

All rights reserved. BYTE and BYTE are registered trademarks of The McGraw-Hill Companies, Inc. Trademark registered in the United States Patent and Trademark Office.



Member Audit Bureau of Circulation

ACTING MANAGING EDITOR Peter Olson

EXCHANGE EDITORS

Amiga Exchange: Joanne Dow Entertainment and Leisure Exchange: Rich Taylor IBM Exchange: Barry Nance Programmers Exchange: Bill Nicholls Professionals Exchange: David Reed Tojerry Exchange: Jerry Pournelle Windows Exchange: Karen Kenworthy Writers Exchange: Wayne Rash Jr. Macintosh and Other Exchanges: At Large INFORMATION ENGINEER

MEMBER SERVICES MANAGER Chuck Greenslit

BIX is the BIX Information Exchange, your best source for technical advice. BIX is owned and operated by Delphi Internet Services Corporation. Find us on the Web at http://www.bix.com/ (all browsers are welcome). E-mail our autoresponder at info@bix.com or fax us at 617-441-4902. Dial us by modem at 800-695-4882 or 617-492-8300 (V.34 28.8kbps). Telnet to x25.bix.com or call us (voice) at 800-695-4775 or 617-354-4137. Connect via packet networks to host BIX. Look in the last few pages of this magazine for our advertisement.

The world is changing faster than you think; don't be caught by surprise!

OFFICERS OF THE MCGRAW-HILL COMPANIES

Founder: James H. McGraw (1860-1948). Chairman and Chief Executive Officer: Joseph L. Dionne; President and Chief Operating Officer: Harold W. McGraw III; Senior Vice President and General Counsel: Kenneth M. Vittor; Executive Vice President and Chief Financial Officer: Robert J. Bahash; Senior Vice President, Treasury Operations: Frank D. Penglase; President, Information Services Group: Michael K. Hehir; Vice President, Information Technology and Communications Group: Kevin C. Harold. The new network CD-ROM server, AXIS StorPoint CDTM, enables you to share and access CD-ROMs over your network fast and easy. It supports all computer systems simultaneously, including Windows NT, NetWare, Unix and Intranet. Place it

NetWare, Unix and Intranet. Place it wherever you want and connect up to seven CD-ROM drives of any brand.

AXIS StorPoint CD^{TM} installs in minutes and operates entirely independent of any file server – no file server down-time. There are no additional costs since AXIS StorPoint CD^{TM} is software and licence free.

To configure simply use a WWW browser or other

existing tools. It works
as an instant WWW
server, with CD's accessible

from your Web-browser in

seconds. AXIS StorPoint CD™ can be

upgraded from 2 to 32 Mb of RAM for faster caching. It's also easy to upgrade the software, for instance over Internet. You can get our new CD-ROM server either as a self contained box or as a tower module for easy tower integration.

For more information on the AXIS StorPoint CDTM and how to get in touch with your national distributor, give us a call or visit us at http://www.axis.se/.

EASY WAY TO NETWORK YOUR CD'S

AXIS StorPoint CD™ does the job.



AXIS
COMMUNICATIONS
Makes Your Ne Work Smarter

Scheelevägen 16 SE-223 70 Lund, Sweden Phone: +46 46 270 18 00 Fax: +46 46 13 61 30 sales@axis.se http://www.axis.se/

Deliver Industrial-Strength Decision Support Tools and Watch the Sparks Fly!

elivering effective decision support for hundreds or thousands of users is definitely not child's play. It takes powerful, mature tools. IQ Software's decision support tools are industrial-strength, best-of-breed products that can be deployed individually or as a total decision support solution.

IQ/Objects™ Robust Query and Reporting

For end-user query and reporting, IQ/Objects is simply unbeatable. This award-winning tool's familiar, easy-to-use Microsoft look and feel belie the awesome power of its true

object-based technology. IQ/Objects supports everything from simple ad hoc queries to the most sophisticated cross tabulations. Reusable objects let users combine new queries and reports with previously saved ones to create sophisticated reports easily and quickly. A selection of tem



reports easily and quickly. A selection of templates makes it easy to create presentation-quality results in minutes.

IQ/SmartServer™ Three-Tier Architecture

IQ/SmartServer provides production reporting, scheduling and job monitoring facilities. This elegant three-tier architecture implementation harnesses the power of servers (UNIX and NT) to reduce network traffic and deliver a scalable, manageable, high-performance solution. IQ/SmartServer cures fat client performance problems without limiting user access to information.

IQ/Vision™ Multidimensional Analysis

IQ/Vision works directly with relational databases and Arbor's Essbase or can be implemented with its own MDDB to deliver a complete OLAP solution. For robust multidimensional and drill-down analysis, nothing is easier to use or functionally as rich as IQ/Vision. An intuitive interface displays information in interactive charts or cross tabs, allowing any user to visually slice and dice, drill up and down, nest dimensions, flip axes, and rotate dimensions – all with point and click simplicity.

"IQ/Objects - A breakthrough technology for query and reporting tools.

"IQ Software has brought the power of objects to mainstream business intelli-

IQ/Vision is an extremely powerful and easy to use OLAP tool that shines with complex data."

Information Week Lahs

IO/LiveWeb™ Web-enabled Decision Support

IQ/LiveWeb links corporate databases and cyberspace, turning your intranet into a source of live database information. With IQ/LiveWeb, users can request and view reports anytime, anywhere using a standard Internet browser. IQ/LiveWeb lets you design and build database reports, charts and cross tabs.

Server-based publishing makes it easy to keep those reports current. Simply tell IQ/LiveWeb the schedule. That's it. IQ/LiveWeb automatically DOWNLOAD executes your requests, refreshing the information and publishing it to your intranet. SOFTWARE

Special Offer! For a limited time, download a fully operational copy of IQ/LiveWeb, valued from \$4,000 to \$20,000, absolutely free. See http://www.igsc.com for details.

Start the sparks flying! Contact us today for details on our industrial-strength tools.

FREE



800-458-0386

info@iqsc.com

http://www.igsc.com

European Subsidiaries & Affiliates: UK (44) 1-962-844-777, France 33 (1) 474-903-04, Italy-Dexia Italia (39) 6-517-933. International Distributors: Australia (61) 2-369-1932, 2-975-7669, 2-436-2788, Canada-Information Access (416) 620-5811, Chile (56) 2-341-4785, Hong Kong (852) 2541-9900, Mexico (52) 5-575-6098, Singapore(65) 298-3838, South Africa (27) 11-421-4800, Spain (34) 50-27-55-11. For distributors in all other Pacific Rim countries, call (65) 334-1936, European countries call the UK office, and all others call IQ Software's U.S. headquarters.

Circle 179 on Inquiry Card (RESELLERS: 180).

PHOTOGRAPH: KELLIE WALSH © 1996

ediforial

Computing Crossroads

Will it be Intel inside or Java everywhere?

his month, our Cover Story (which is the State of the Art section) highlights the most radical bid in years for a new computing platform: Sun Microsystems' Java chip/Java language combination. This is not just an alternative to Intel/ Microsoft computing, à la the Power-PC/Mac OS package. It's a reinvention of the computer into a more universal, versatile, and interoperable device. The Java model could obliterate many of the distinctions between standard computers, embedded systems, and products still to come, such as intelligent cable boxes and cellular phones.

For years, we've lived with chips that will run almost anything and languages that will run on almost anything. Java chips will give us performance where we need it—running Java applications—while the Java environment will give us interoperability with every other hardware platform.

Sun hopes that electronic designers, corporate information technology (IT) departments, and, ultimately, end users will find this so compelling that they will leave behind the Intel architecture. However, it's a tall order. Look at how hard it's been for the mighty PowerPC troika of Apple, IBM, and Motorola to make headway against the x86 line.

Still, I think Sun will win a significant place with its Java chips. In the last year, we've started to hear some awful gnashing sounds coming from Redmond, as Microsoft grinds off a few gear teeth trying to keep up with the paradigm shift toward the Web. On the hardware side, Intel hasn't made any major adjustments to the infobahn. Check out our story on Intel's road map ("The x86 Gets Faster with Age") on page 89, and the only new signs that you'll see are those for mul-

timedia. Keep those MIPS coming!

There's no question that simpler, cheaper, faster PCs will spread computers to people who have never used them before. As business communications and public commerce march relentlessly toward computerization, the network computer (NC), or Web PC, or whatever you call it, will proliferate (see "Inside the NC" on page 105). Ditto for new devices we haven't named: the wireless gameboyphonebrowseremotecontrol and such.

But Sun may be ahead of its time. When will the network infrastructure arrive to make fully networked computing possible? It will definitely be a year that begins with 20 before we have the kind of end-to-end digital broadband network we'll need.

So don't put all your money on one horse just yet—you'll need both Java and



think about computing. Can it be a coincidence that Microsoft has revived its hand-held computer OS project, now called Pegasus? Or that Oracle hopes Intel will buy into its Network Computer concept? That's not the end of it: Look for

It will be a year that begins with 20 before we have the kind of broadband network we'll need.

Wintel for the foreseeable future. Java chips and the Java language will solve some of client/server's thorniest problems. (Do you really want to individually maintain hundreds of PCs that are nothing more than cash registers or data-entry terminals?) The Java duo will also make lots of cool but dumb stuff like cellular phones much smarter.

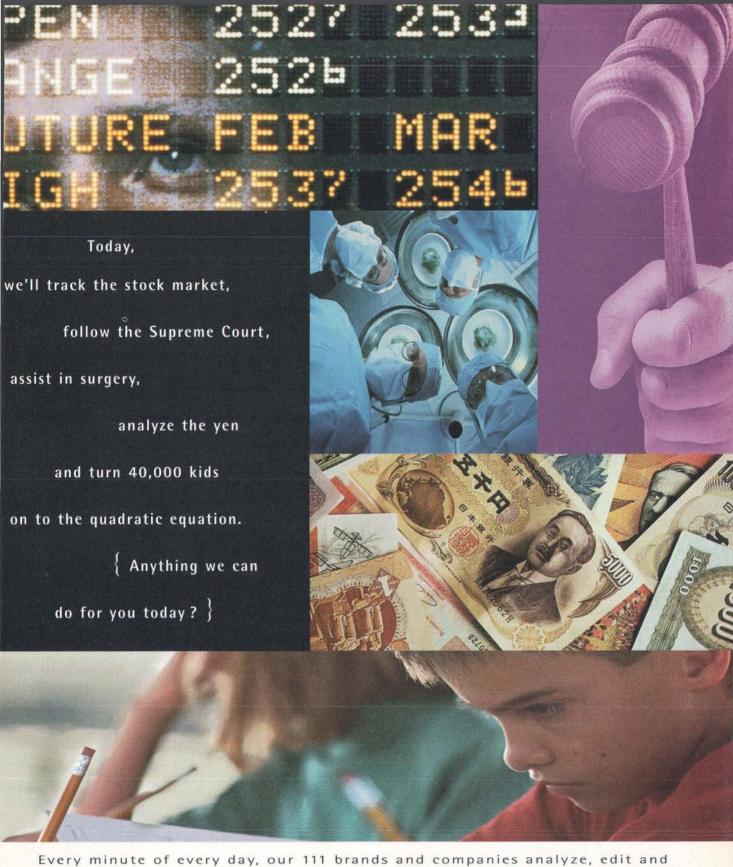
Yet our familiar OSes and applications make the classic PC—Intel, PowerPC, or whatever—much more flexible than those devices will ever be. Throughout the next decade, I may want a Java unit for the office and a self-sufficient but connectable machine for computing on airplanes or when I'm otherwise outside the wired urban hubs of the world.

Win, lose, or draw in the commercial war, Java has already changed the way we traditional OS vendors to let you turn the desktop GUI into a screen onto which you project server-based applications, NCstyle.

Users' interests lie in being able to flexibly combine the best elements of the Java concept with the best of what we have now. For example, products such as Notes and higher-end database managers can choreograph local and centralized data management. Make that skill widely available to all sorts of applications, and we'll have the best of both worlds.

Mork Schlack

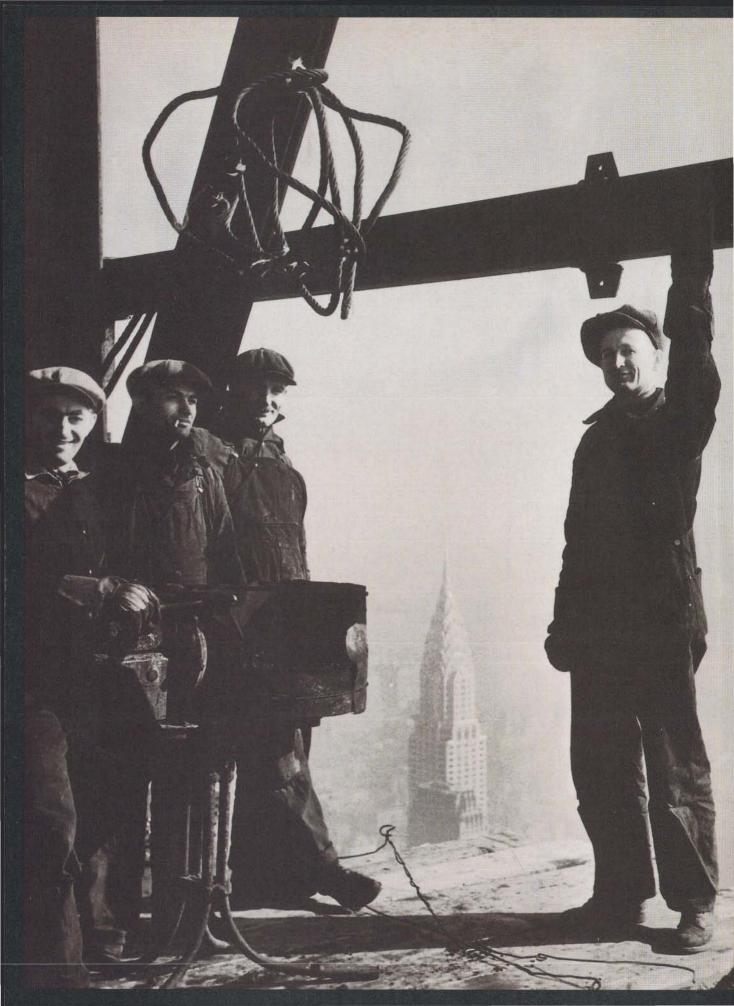
Mark Schlack, Editor in Chief mschlack@bix.com



Every minute of every day, our 111 brands and companies analyze, edit and interpret information for an ever-changing world. So you can make the most of it.

The McGraw·Hill Companies

Keeping the world up to speed



www.teledotcom.com

0

SITE TOB: SEEN





New 33MHz Intel 386" EX embedded processor

The Leading Realtime OS for PCs

QNX RTOS with Photon microGUI™

New RadiSys R380EX system controller



The New EXPLR2: All the hottest embedded technologies on one

Combine the latest products from the leaders in embedded PC technology and what do you get? Faster time-to-market. More functionality with less hardware. A longer production life for your Intel's EXPLR2 makes your design work easy. All the hardware

you need is fully integrated, so you can start prototyping right away. yet, the design-capture files come included. Just cut and paste to create your custom system.

The EXPLR2 also comes with QNX, the realtime QS that delivers high-end performance, even and a full-featured.

The EXPLR2 also comes with QNX, the realtime QNX gives you a postx-certified environment and a full-featured.

you need is fully integrated, so you can start prototypill you need is fully integrated, you can start prototypill you need it is fully integrated, you can start prototypill you need it is fully integrated, you can start prototypill you need it is fully integrated, you can start prototypill you need it is fully integrated, you can start prototypill you need it is fully integrated, you can start prototypill you need it is fully integrated, you can start prototypill you need it is fully integrated, you can start prototypill you need it is fully integrated, you can start prototypill you need it is fully integrated, you can start prototypill you need it is fully integrated, you can start prototypill you need it is fully integrated, you can st The EXPLR2 also comes with UNX, the realtime OS that delivers high-end performance, even on low-cost hardware. Exceptionally small and fully scalable, QNX gives you a POSIX-certified environment and a full-featured full in under 1MB of memory! The EXPLR2 comes with something else. Commitment. With

their long-term commitment to embedded applications, Intel, GUI in under 1MB of memory!

RadiSys, and QNX Software Systems are the right companies to give your designs a real future. Radical!

For your free reference design kit, surf: www.explr2.com or call: 800 862-1883 (to order a board, contact your Intel distributor)

Circle 159 on Inquiry Card.

Intel and Intel386 are registered

Intel and Intel386 are registered

Intel and Intel386 are registered to a registered to RadiSys \s a registered to

MOOX

The Future On-line

I found the vision of the online future that Mark Schlack described in "Smart, Fast, and Well Connected" (September Editorial) stimulating and bracing. However, I don't believe that vision will be fully realized until the companies concerned with building the global infrastructure forget the idea, at least for a quarter of a century, of making substantial money out of it. The Internet arose out of a sense of collective experimentation that had little to do with the profit motive. Tim Berners-Lee is not as wealthy as Bill Gates by a long way! Paul Richards East Finchley, London

I agree it will take visionaries to make the intelligent network happen, but they won't have to ignore the profit motive. For some time, the telecom industry has been making the transition from hardwired, inflexible switches to a software-defined network, and for their own reasons: efficiency, manageability, expandability, and the ability to sell value-added services. Once the network is programmable, nearly anything is possible. The biggest obstacle will be for carriers to act more from their customers' perspective. -Mark Schlack, editor in chief

Wizard Review

Kudos to BYTE for the crisp and substantive review of the OS/2 Warp 4.0 beta ("You Talk, Warp Listens," September). I have my sights set on installing Merlin as soon as it arrives, and the article gave me sufficient edge to coordinate my programming strategy starting today. Now I will pass around that issue of the magazine to my 30 OS/2 coworkers, and I will buy future issues.

Mark A. Ehlen

Germantown, MD

me13@cornell.edu

Cover Story Uncovered

BYTE is usually pretty good, but the August cover is misleading. There is no article called "Run Your Business on the Web" but rather something called "Your Business Needs the Web." These are not even remotely the same thing. To run a business you need marketing, production, financial, and personnel strategies. Your article doesn't touch on these. And yes, I really did expect it to, or at least to show examples of businesses that are unique in how they exploit new opportunities enabled by the Web. I don't care what not-for-profit organizations like NASA and Harvard are doing with mammoth budgets and half the brainpower in the free world; show me what economies my business can achieve or how it could be transformed in the short as well as the long term.

Greg Graham gregg@idacom.hp.com



Refreshing!

I get sick of all the hype and misrepresentation about the huge shift that has happened with the Internet. So many articles, so little substance. "Your Business Needs the Web" was different. It was well written, well researched, and informative-a breath of fresh air. I think you actually touched on the real issues, challenges, and exciting prospects facing all us poor slobs who have to implement this stuff. Rvan Sutter

Ryan.Sutter@mortenson.com

Thanks! Used to be, I wrote about a lot of things that were far removed from what I did on the development side of BYTE's business. Now I build things and write about what I learned. What cuts through all the Internet hype for me is simply the fact that this has become possible. It's just plain exciting. —Jon Udell, executive editor

Inspiration and Perspiration

Let me be the one-millionth customer to point out that Thomas A. Edison did not exactly work "on his own" in his lab ("The Elements of Design," August). He may have in the early days, before he set up his lab, but not later. He had lots of assistants with whom he interacted and to whom he assigned "polishing up" tasks. Many historians feel that those people received nowhere near the recognition they deserved.

K. Steven Knudsen, Ph.D. Resolute Research Ltd. Calgary, Alberta, Canada

You're not quite the millionth customer to point this out. However, you're the first to realize that I was talking

HOW TO CONTACT U

ON THE WEB

Visit The BYTE Site! Search our archives. Download articles. See industry press releases. Join on-line conferences with other BYTE readers! www.byte.com.

> BY FAX (603) 924-2550

BY E-MAIL

Address letters to editors@bix.com. To reach individual BYTE editors, see The BYTE Site on the Web for a directory. Letters may be edited for publication.

BY POST Editors, BYTE, One Phoenix Mill Lane, Peterborough, NH 03458

SUBSCRIPTION CUSTOMER SERVICE

U.S. only: (800) 232-2983; international: (609) 426-7676; or see www.byte.com/admin /mpcstsvc.htm

For advertising and other noneditorial contacts, see page 10 or click on the Information link on The BYTE Site. inbox

about his early days. I certainly did not intend to rewrite history. It might have made good closure to the article to point out that Edison adopted this administrative model for his research work. The same model is used today, but on a larger scale. —Tom Thompson, senior technical editor

Token Token Ring

In this age of political sensitivity, I was disappointed to see you slip into a minorityunfriendly attitude in "Mainstreaming Pentium Pro" (August). No, you didn't bash a political minority-just a technical one. A significant portion of the networked world uses Token Ring, and we know that "built-in networking" is media slang for "built-in Ethernet," which for us translates into "a tax on minorities." May the Deity, if H/She exists, bless AST for not wasting the electricity and materials for such a device on those of us who live happily without, Otherwise, nice job! Tim Schultheis Victoria, MN

OS Insecurity

In "Air-Tight Windows NT" (August), author Jim Reynolds states that the U.S. National Security Agency granted Windows NT 3.5 C2level approval. What few people know is that this evaluation was limited to a stand-alone computer and did not include network interfaces. If a user hooks up an NT server to a network, the computer can no longer be considered C2-secure until almost all network functionality is disabled. Failure to mention this is

misleading and lures users into a false sense of security. The article also doesn't mention the so-called "boot floppy" vulnerability of Windows NT. By booting from a floppy and using assembly language utilities, a person can bypass NT security and can read, write, and delete files from the hard disk without leaving a trace.

Karl Pottie Rumbeke-Roeselare, Belgium karl@vl-brabant.be

The security features I discussed also apply to networked computers. NT is currently undergoing network evaluation (the NSA usually conducts stand-alone and network evaluations separately). But remember, the evaluated configuration, which includes hardware and software, might not match what you have or need. The NSA team was aware of the boot-with-floppy issue; the evaluated configuration prohibited physical access to the floppy. A less stringent need for security might take advantage of the common PC feature that prevents booting from a floppy. Of course. without physical security this solution can be circumvented. The bottom line is that if you can boot a different OS, then none of the security mechanisms of NT work. This is to be expected with any OS. What makes the NT case appear different is the ubiquitous character of the hardware platform and the fact it is generally designed to boot from floppy, unlike older, time-sharing systems such as Unix. -Jim Reynolds

Xyratex Omitted

While your news story on Serial Storage Architecture ("SSA Products Deliver Better Storage," September
Bits) was informative, it
neglected to mention that
Xyratex supplied the pair of
eight-SSA-disk deskside tower units (S9000) for BYTE's
testing of this hot technology. We also manufacture single-SSA-disk desktop models
and 16-SSA-disk rack-mount
units, as well as SCSI RAID
devices and a complete line
of test equipment for SCSI,
SSA, and Fibre Channel
interfaces.

Roger Nixon Xyratex International Ltd. 71740.3316@compuserve.com

Mr. Nixon is correct. We apologize for the oversight.

—Editors

Apache

I've been reading your Web Project column on Web site management with growing amazement. How can you continue to write about the Web without ever mentioning the world's most popular Web server, Apache? Apart from this glaring deficiency, it's an interesting column. Ben Laurie Freelance consultant and technical director A.L. Digital Ltd.

A.L. Digital Ltd.
London
ben@algroup.co.uk

I use Apache on my main
conferencing server, a Lin

conferencing server, a Linux machine, and, in fact, I mention that in this month's Web Project. Currently, I'm experimenting with dualmode NNTP/Web conferences, where the primary message base is handled by INND, but a Web viewwhich now includes posting as well as reading capability-echoes the message base using Apache. The conference, which will now become an ongoing accompaniment to the column, is

at http://dev4.byte.com/joncon/threads.html or news:// dev4.byte.com/joncon. —Jon Udell, executive editor

Java and Forth

After reading your August issue with all those Java articles and code examples, it became very clear that we old-timers can pull our Forth manuals out of storage and put them to use again. If Java basically is Forth, is this a copyright infringement? Thomas A. Naegele, DO Albuquerque, NM tanman@swcp.com

The Java and Forth virtual machines do share many common elements, but the syntax of the Java language is quite different from Forth's.

—Rick Grehan, senior technical editor

Why Not Tao?

In "Weird, Wacky, and Wonderful" (August Editorial), you question whether distributed computing can be made to work. The technology to do this already exists in the form of the Tao operating system, which has been reported on by your own U.K. correspondent, Dick Pountain, in "Parallel Course" (July 1994). The big advantage of the Tao OS's translated system is that the speed penalty is only about 1 percent; this leads inevitably to the fact that it reduces the processor to a commodity item, something that can only benefit the consumer. For more information about Tao's technology, go to http://www.tao.co.uk/. Russel Hughes rhugesc@cix.compulink.co.uk

Tao Systems is still actively talking to telecom and elec-

Three-peat
Unprecedented Winner of

3 Editor's Choice Awards in 1996



September 24, 1996 SAG STA Pentium Pro 200



February 20, 1996 SAG STF 166 Pentium



February 20, 1996 SAG STF 150 Pentium

WORKSTATIONS

Want a custom built system?

Until SAG, that meant high-priced VARs and other costly consultants.

Want to pay less for your system without compromising on quality?

Until SAG, your only options were pre-configured systems and their many limitations. SAG uses only the highest quality components the marketplace has to offer and still provides you with the best cost!



Don't Settle for Less.

We don't build it until you buy it! Now you can have custom quality configurations without compromise. All SAG solutions are precision-built and packed with features. We offer the latest in technology, with speed, data integrity, and compatibility in mind. For affordable disk arrays, tape backup solutions and RAID 5 technology, SAG Electronics is the acknowledged "High-End Solutions Company."

The Choice Web Server

Companies like Business Week Magazine are choosing SAG Electronics as their high performance web server solution.

Juad Pro 200MHz RAID 5	Dual Pro 200MHz SMP	Pro 200 Workstation	Alpha 433 Power System	Dual Ultra 200MHz
2 Intel Pentium Pro® Processors Exp. to 4	Intelligent Management System reduces cost of ownership.	I Intel Pentium® Pro Processor	256 Bit Bus	1 Intel Pentium® 200MHz Processor, Upgradable to 2
64MB of ECC 4 way Interleaved	Built-in Expandability with SMP Natoma Chipset	32MB of 60 NOS	1MB SRAM Cuche	CPUs Triton II Chipset
Memory to 1GB	1 Intel Pentium® Pro 200 Processor	EDO RAM Expandable to 128MB	1 DEC 433MHz Alpho CPU	32MB RAM Expandable to 256MI
Slots (6) PO; (4) EISA	32MB of 60 NOS RAM Expandable To 512MB	ECC Supported	i occ soomie Ajiila ci u	Slots (4) PO, (4)EISA
Adaptec 3940 UW	ECC Supported Imagine 128 Series II	SLOTS: (4) PCI,	64MB RAM to 1GB	Sony 8x CD-ROM
Quantity: 3, 4.1GB UW Removable HD	4 MB VRAM	(4) ISA	8x CD-ROM	Flappy, Mouse
RAID 5 Ultra Wide Controller 8x CD-ROM	Integrated on Board: -Adaptec 2940 UW -16-Bit Sound Cord	3GB 5400 RPM 9.5ms HD	ELSA Gloriz 8 Video Cord	Imagine 128 Series II 128 Bit "3 4MB VRAM Video
#9 2MB DRAM Video	- Intel 10/100 PCI Ethernet	Motrox 2MB WRAM Video		2940 UW
8GB DAT Drive	Asic for Hardware Manitoring 4.1GB Ultra Wide	16 Bit Sound Card	4GB 7200 RPM	2.1GB Ultra SCSI Wide HD (8.5m
Quad PO Ethernet 10/100	SCSI HD	Sony 8x CD-ROM	SCSI Wide HD (8ms)	32 PNP Sound
Floppy, Keyboard and Mouse	Sony 8x CD-ROM	Keyboard, Floppy,	Slots (4) PCI, (2) ISA,	Midtower Case
12 Bay Tower 450 Floppy, M Watt Power	Keyboard, Floppy, Mouse	Mouse Midtower		MAG 17DXT Monitor
	Tower Case 300 Watt		Tower 300 Watt	53530
\$13000	53350	\$2159	57990	Single Processor Matherboard Solution \$3280

f&T on-site and 4 year extended w it been approved by the Federal Com-mined. GSA Schedule #GS-35F-3103E



508-682-0055 Fax 508-689-0180 Hours: 8-30am-7-00pm, Monday-Friday EST 5 Year Limited Warranty

http://sagelec.com

High Quality Custom-Configured Systems at Off-the-Shelf Prices

We've solved your inter-connecting puzzle.

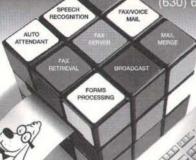
Avoid the twists and turns in choosing your communications software. FaxFacts is your one stop source for enhanced fax/voice solutions.

- · Fax documents from any Windows application
- · Complete transaction
- · Total network support

TRY THIS DEMO 847/923-3030 DOC NO 889812

- · On-line credit card authorization
- Fax over network from multiple workstations

Copia International Ltd (800) 689-8898 630) 682-8898



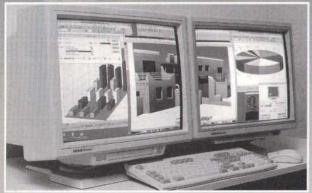
SEE US AT COMDEX

BOOTH S4661

Multi-screen Windows NT System

controls from 2 up to 12 monitors using PCI bus based single- or multi-channel graphics boards in a PC.

The NT-Wallx product supplies a large virtual screen of multiple monitors for the Windows NT user in a PCI bus based PC system. NT-Wallx consists of graphics software drivers and PCI graphics boards. All Windows 3.1., Windows 95 and Windows NT compatible applications can be run on the large screen of multiple monitors



Resolutions for one channel from VGA up to 1280x1024 or 1600x1200 pixels. Applying 4 graphics channels with 1600x1200 resolution each and 4 monitors in a 2 by 2 configuration can reside a 3200 by 2400 pixel total resolution for example

Specifications Compatibility Controllers Accelerator No. of boards

Windows NT Workstation 3.51 or 4.0 single- or three-channel PCI boards S3 or Weitek from 1 up to 4 in one system from 2 up to 12 in one system Resolution from VGA up to 1280x1024 or 1600x1200 each monitor screen Total resolution sum of all monitor screens PCI motherboards with Platform

DEXON Systems Ltd. For all technical and commercial questions: Fax: +36-1393-2618 Phone:+36-1393-2617 E-mail: sales@dexon.datanet.hu Web: http://www.datanet.hu/dexon

Distributors' fax: USA: +1-310-941-5757 Japan: +81-337-679-709 UK: +44-1959-700-300 All other countries please fax: +36-1-393-2618

Customized and UNIX based solutions are available

tronics companies but has vet to name any licensees. That's why we haven't covered the Tao operating system recently. If any deal is announced or new development occurs, we'll be sure to mention it.—Dick Pountain. contributing editor

FIXES

Due to editing errors, we omitted some text in "Cvrix 6x86 Matches Pentium," (September Bits). The \$1500 price we cited in the article was meant to refer to the approximate cost of the SCSI controller with 64 MB of memory, not the entire system. The price at the end of

the story is the correct approximate system price. We also said the Cyrix system had 64 MB of RAM. The SCSI controller had 64 MB of memory; the Cyrix system itself had 32 MB of RAM.

The rightmost graph in the figure "SOL Server Performance" on page 162 of the Quad Pentium Pro Server comparison (September) was mislabeled. The scale at the bottom should have read 1 to 4, reflecting the number of processors.

In "Microsoft Catches Up with Netscape" (September), we referred to "Sun's JavaScript." JavaScript is a Netscape product.

COMING UP IN DECEMBER

COVER STORY The Microprocessor at 25

BYTE examines how, in 25 years, the microprocessor has changed the world. We'll also explore the evolution of microprocessor design and where it's going, and we'll bring you the views of industry luminaries on the impact of future advances in computing technology.

EXCLUSIVE! **Hot New Processor**

We take a detailed look at Exponential's PowerPCcompatible bipolar chip, which delivers clock speeds in the range of 500 MHz.

STATE OF THE ART **Next-Generation Internet Applications**

As a platform for distributed applications development, the Internet is dynamic but immature. BYTE takes a close look at evolving standards for directory services, e-mail, and security and explains what they'll mean for developers deploying enterprise-wide applications on the Net of 1997 and '98.

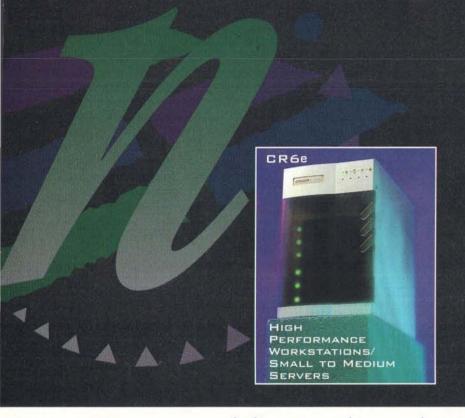
HARDWARE LAB REPORT **Network Laser Printers**

NSTL tests monochrome laser printers with output speeds of 17 to 32 pages per minute. Here's where to find the one that can meet the needs of large corporate departments and small businesses.

SOFTWARE LAB REPORT Lotus Notes and Microsoft Exchange

Which of the groupware heavyweights is best for your business? NSTL's in-depth report will help you decide.

What is nStor?







Manageable Fault-Tolerant Storage

Lasting quality and reliability are built into every *n*Stor RAID system. From the easy-to-use Alert Manager software to the redundant hot swap components, data integrity is our first priority *n*Stor systems.

integrity is our first priority. nStor systems

are the first to incorporate
the SAF-TE (SCSI
Accessed Fault-Tolerant
Enclosures) standard
which is leading-edge

CRB

technology to protect your investment. In addition, nStor utilities provide unmatched manageability which allows

you to switch RAID levels or capacity on-the-fly. You can also configure a hot spare for automatic data reconstruction without user intervention. So whether you're look-

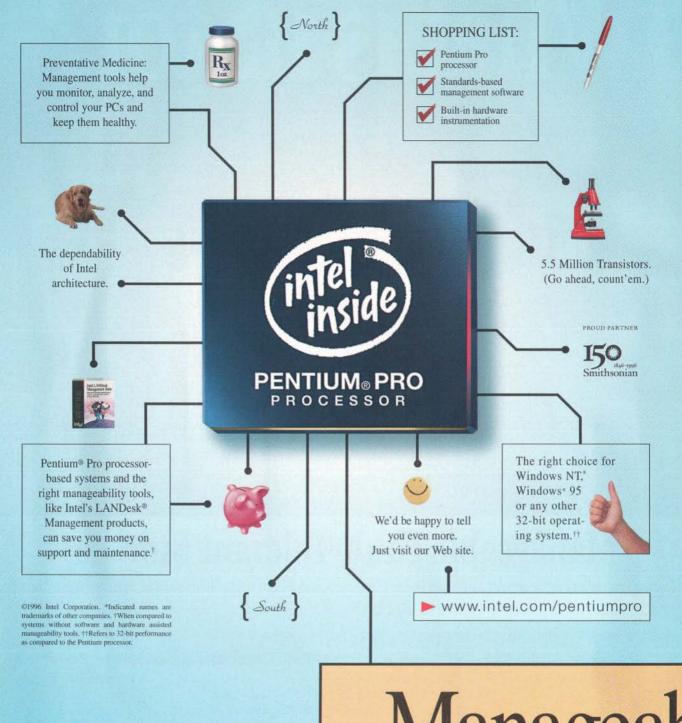
MANAGEABILITY ing for manageability or reliability nStor
RAID systems meet
your needs. nStor systems support RAID levels 0, 1, 3, 5 and
are compatible with FAST

WIDE SCSI, Call for more information or visit us on the web at http://www.nstor.com/



nStor. Formerly Conner Storage Systems
1.800.RAID511 ▼407.829.3500 ▼ Europe: +44(0)1234 213571

@1996, nStor Corporation, Inc. All trademarks are of their respective owners. Specifications subject to change without notice.



Manageab

man"ăġe·à·bil'i·ty,

n, the ability to simplify and automate the maintenance and support of business computing with the right hardware and software tools, i.e., Pentium Pro processorbased systems with the right manageability software.

ility defined.



oits

Windows for Tiny PCs

Seamless information synchronization with desktop PCs will highlight Windows CE.

f at first you don't succeed, try again. Following an earlier effort to develop an OS for hand-held devices, Microsoft will release an OS called Windows CE this fall. The first products based on the new OS, which is code-named Pegasus, will be hand-held PCs that are about the same size as today's Psion 3A and Hewlett-Packard's 200LX.

Unlike these other devices, however, the new Windows CE hand-held PCs will feature an OS that provides a Windows 95 look and feel. Windows CE will also offer programmers a subset of the Win32 APIs, making it easier for developers familiar with those interfaces to write applications for these new hand-held PCs. Microsoft says that Windows CE will also be appropriate for such items as cellular smart phones, digital information pagers, and entertainment and multimedia consoles.

The first Windows CE hand-held PCs will likely be released late this year. They will ship with slimmed-down versions of popular applications such as Microsoft Excel and Word, although the CE versions will probably offer only some of the features available in desktop applications. The devices will reportedly let you synchronize information with Schedule

Windows CE Highlights

- # Good PC connectivity
- Programming interface based on Win32
- Windows 95 look and feel
- Backed by several hardware manufacturers
- Device price near \$500
- First release slated for this month

Plus and possibly other calendar programs from your desktop.

Microsoft declined to comment in depth on the devices or the OS, but company officials say the hand-held PCs will offer strong connectivity to Windows PCs. Initially, companies such as Casio, Compaq, HP, LG Electronics, NEC, and Philips Electronics will offer them. Compaq, perhaps PDA-shy from its initial work with the abortive WinPad OS, will reportedly resell a hand-held PC made by another company.

Windows CE is a 32-bit, multitasking, multithreaded OS. It is also portable to a variety of microprocessors, such as Hitachi's 32-bit SH3. Processors from NEC Electronics and Philips Semiconductor can also be used in Windows CE handheld PCs. The OS will be stored in 5.5 MB of ROM, according to reports.

These hand-held PCs will probably sell for about \$500. Whether they will be breakthrough products that breathe new life into the market or just another bust in a field littered with failures remains to be seen. However, even if Windows CE isn't perfect in its first release, it's possible that Microsoft will continue to improve the product until it is as popular in the hand-held PC arena as Windows 95 is on the desktop. —Dave Andrews

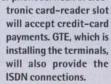
geek mystique

Surf Now, Fly Later

From 3Com (aka Candlestick) Park to rock concerts, Internet-access terminals are

showing up in various mainstream venues. Now they are also arriving in airports and hotels. Atcom/Info, which is a San Diego-based provider of public communication and information resources, will have 10 of its Internet-access kiosks (see the picture) installed at Dallas-Forth Worth International Airport. From there, business travelers will have access to e-mail, the Web, Inter-

net newsgroups, ticketing services, information about local attractions, and other information. Each kiosk will have one sitdown and one stand-up access terminal, plus two stations for phone service. An elec-



If you're too busy to stop at the airport to do some Web surfing, or to dash off a last-second e-mail message, perhaps you can do so when you get to your hotel. Atcom/Info is developing Internet-access systems for hotels that will



Web Surfing at DFW

allow busy business travelers to log in on the road even if they have forgotten their notebook.

-D.A.

Web Info the Way You Want It

The strength of the Internet, its vast collection of information, is a double-edged sword. You can spend hours looking for something without finding it. To address this problem, several new products and services let publishers deliver information over the Internet in a focused way to the people who most need it.

Search tools such as Yahoo and Alta Vista can help you find something more quickly on the Web, but sometimes you still have to browse through many bad hits before you find what you want. Off-line browsers can download information from Web sites while you sleep, but they don't help if your job requires instant access to the latest information. If you've configured your off-line browser to download information at midnight, you may not get an important piece of news that breaks

yeah, but...

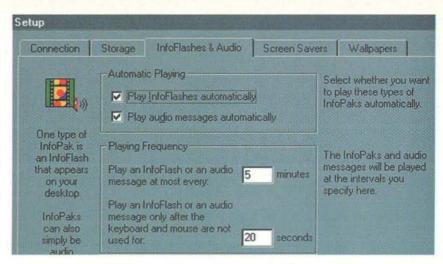
The Internet is growing so fast that we can't keep up with it. It's where everything cool in the computing world is happening, and nothing can stop it from growing.

Yeah, but a recent report by Yankelovich Partners (Norwalk, CT), a market research firm, indicates that the Internet is at a crossroads, and that unless the cost of access devices such as PCs and modems improves, the rate of Internet growth will decline. The firm says the annual average growth rate in the number of cybercitizens will decline to 20 percent by the end of the year unless the price to play on the Internet comes down. Another caution flag: Between May 1995 and May 1996, average on-line time fell by 25 percent, from just over 16 hours to 12 hours.

early the next morning for another 24 hours.

New services that address the above problems let information-oriented businesses deliver just the news you care about directly to your PC. Subscribers to these services specify topics they are interested in, such as business competitors or stock prices. When news about those topics breaks, it is sent to your PC.

Pointcast's (http://www.pointcast.com) advertising-supported service allows you



BackWeb can deliver news as an audio message, a news flash, or in an information package.

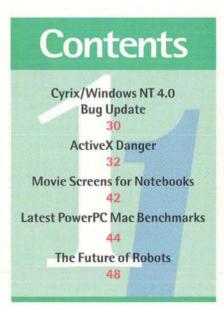
to customize which kinds of topics you want to know about from a variety of news sources, such as Reuters, newspapers, and others. A new product from Pointcast called Iserver (\$995 per server CPU) lets corporations distribute information more efficiently over an intranet.

BackWeb's (http://www.backweb.com) namesake product suite lets content providers create information-delivery broadcasts and send information to a wide audience or just a single end user. The BackWeb server console lets you track detailed statistics of how users interacted with information, and a scripting language allows you to control how information appears at the end user's desk. WavePhore (http://www.wavo.com) is also getting into the Internet and intranet real-time news-delivery business to complement its current broadcast services. And NetGuide (http://www.netguide.com), an on-line guide to the Web, will deliver content based on your information preferences.

One problem for would-be content providers is that some of these server platforms can cost thousands of dollars. That price is prohibitive for many small-size and midsize businesses, says Ross Rubin, senior analyst with New York City-based Jupiter Communications (http://www.jup.com), an Internet consultancy. He also says that a subset of what vendors such as Pointcast are offering may be available in a few years from standards-based Internet e-mail and even sooner from Web-server and database vendors.

John MacFarlane, CEO of software.com (http://www.software.com), a provider of standards-based Internet mail servers, agrees. Already, says MacFarlane, the new

IMAP 4 standard lets mail users store Internet mail on servers instead of having to pull them onto a client machine. This lets active agents automatically file mail to the correct folder on the e-mail server. Although this filtering doesn't currently approach the level of functionality offered by services such as Pointcast and BackWeb, MacFarlane points out that the standards will continue to evolve. Also, discussions are under way among vendors to improve the integration among e-mail server and client programs. Improved integration would let someone using a program such as Qualcomm's Eudora create sophisticated filters that work well with any standard Internet mail server. Until then, products such as Pointcast provide a valuable filter for people who want targeted, fresh information updates. -D.A.



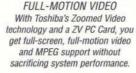
PICTURE THIS: 6X CD-ROM, 11.3" DISPLAY AND ZOOMED VIDEO.

NOW PICTURE THIS: \$2499.





PENTIUM® PROCESSOR -A 100MHz Pentium processor and 40MB of EDO memory can speed up any multimedia presentation. Plus, the 2.9v processor was designed specifically to maximize notebook battery life.



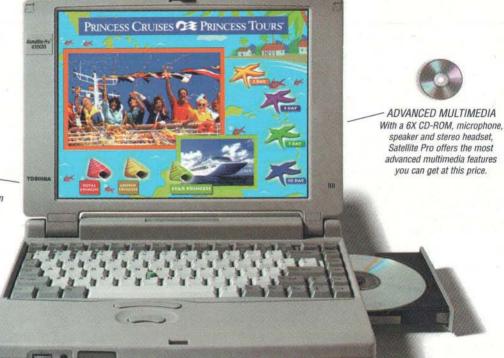
11.3"

800 x 600 RESOLUTION Sure, the screen is huge. And it also has 800 x 600 resolution, which means that every inch of viewing area delivers crystal-clear definition and vibrant colors.



EXPANSION -

Satellite Pro's two PC Card slots unlock a world of expansion capabilities. And the optional NoteDock "I Enhanced Port Replicator offers additional PC Card slots as well as easy connection to your desktop setup.



INTRODUCING THE NEW SATELLITE PRO. When it comes

to multimedia features, the Satellite Pro offers the big picture at a small price. It all starts with a huge display and full-motion video to make your multimedia presentations look more like feature films. And it's easy to take your show on the road with a 100MHz Pentium processor, up to 40MB of memory and a massive hard drive.

a 100MHz Pentium processor, up to 40MB of memory and a massive hard drive. Windows Add to that a 6X CD-ROM, integrated AC adapter and PC Card slots and you've got



more than you need to get the job done. So when you want some real portable power, pick up the Satellite Pro. No other notebook can give you so much for so little. For more information visit the Toshiba website at http://computers.toshiba.com, or for a dealer near you, call 1-800-457-7777.

Satellite Pro

420CDT *

- 11.3° dia. color active-matrix TFT display
- . 1.3 billion byte (=1.26GB) hard drive *

420CDS *

- . 11.3° dia. color dual-scan DSTN display
- 810 million byte (=772MB) hard drive

BOTH MODELS

- 100MHz (2.9v) Pentium[®] processor
- 8MB of EDO DRAM expandable to 40MB
 Modular 6X CD-ROM and 3.5* floppy
- drive, swappable in the SelectBay*

 MPEG support via 7V Port technology
- (requires optional PC Card)
- · HiQVideo" graphics controller

- 16-bit Sound Blaster* Pro compatible audio system with microphone, speaker and stereo headset
- Two stacked PC Card slots (two Type II or one Type III)
- · IrDA compliant
- · Lithium Ion battery
- Integrated AC adapter
- Optional NoteDock" | Enhanced Port Replicator
- Windows® 95 or Windows® for Workgroups included
- · 3-year limited warranty
- Toll-free technical support –
 7 days a week, 24 hours a day

In Touch with Tomorrow TOSHIBA

The World's Best Selling Portable Computers.

©1996 Toshiba America Information Systems, Inc. All prices, specifications and availability are subject to change. Thrice is for 420CDS model, price of 420CDT model begins at \$3299. *The 420CDT and 420CDS are sold at selected resellers as the 425CDT and 425CDS with Windows* 95 and additional pre-installed software. ***The 425CDT comes with an 810 million byte [=772MB] hard drive. All products indicated by trademark symbols are trademarked and/or registered by their respective companies. Intel Inside and Pentium Processor Logos are trademarks of Intel Corporation.



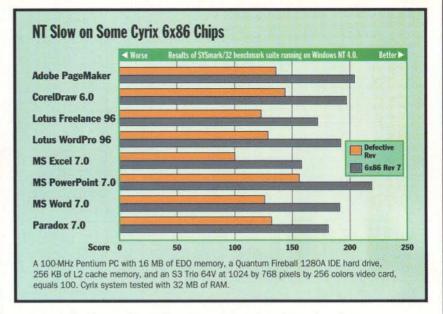
Cyrix 6x86 Bug Puts Brakes on NT 4.0

Cyrix has apparently fixed a bug in its flagship 6x86 processor that results in sluggish performance of Windows NT 4.0, but not before chips affected by the bug reached the market. This bug, uncovered by Microsoft during its prerelease tests of NT 4.0, caused the new OS to crash. To guarantee NT 4.0's stability, Microsoft added code that disables writeback caching in the 6x86's on-board cache. Tests BYTE performed on a Cyrix PC with the 150-MHz 6x86-P200+ processor revealed that applications running under NT 4.0 on a Cyrix chip containing the bug suffered a performance degradation of about 30 percent, compared to later revisions of the 6x86.

Cyrix says it hasn't identified the specific problem in the 6x86 that caused the instability during Microsoft's testing. "We're trying to figure out what exactly is going on," said a Cyrix spokesman.

BYTE has confirmed that a new version of the 6x86 (designated as revision 2.7 by Cyrix) doesn't exhibit the slowdown, indicating that NT 4.0 can distinguish between defective and fixed versions of the chip. If NT 4.0 detects one of the fixed chips, it runs at standard speed with the chip's internal cache fully enabled.

Cyrix would not specify what changes



Real-world applications show the 6x86 slowdown.

it made in the chip or the manufacturing process between revisions 2.6 and 2.7 that may have fixed the problem. Company officials said it is Cyrix's policy not to discuss the specifics of chip revisions.

When asked about the 6x86/NT problem, Microsoft stressed that NT 4.0 is stable on all certified platforms, including all versions of the 6x86. Once Microsoft discovered that a 6x86 couldn't complete the company's so-called stress tests, it alerted Cyrix, and both companies developed a workaround for the problem.

In the workaround, the companies added a series of instructions to NT 4.0 to

identify problematic 6x86es. When a chip with the bug is found, NT 4.0 changes the chip's internal cache operating mode from write-back to write-through. As a result, all memory writes, even those cached inside the chip, force an access to system memory. This change let the 6x86 complete Microsoft's testing, but at the cost of reduced system performance. Cyrix says it is investigating whether a software patch to NT 4.0 will correct the problem. The company also says that other members of its 6x86 family that run at slower clock speeds may be affected by the NT slowdown.

Measured by the SYSmark/32 benchmark suite of eight real-world Windows applications, a 6x86 with its write-back caching disabled turns in poorer NT 4.0 performance than a 133-MHz Pentium. One vendor who sells Cyrix-based systems didn't seem worried by the performance problem. Art Afshar, who is president of Micro Express (Irvine, CA), said that most of his customers buy a 6x86-based PC to run Windows 95 and choose the Pentium Pro to run NT. However, about 25 percent of the people who responded to an article about the Cyrix/ NT performance slowdown that BYTE posted to its Web site said they had either bought or were strongly considering a 6x86-based PC as a platform for running NT. Afshar said that the company will replace the chip for customers with slow NT 4.0 performance on a 6x86.

Cyrix recently began direct-marketing

future watch

Cruising Twenty-First Century Style

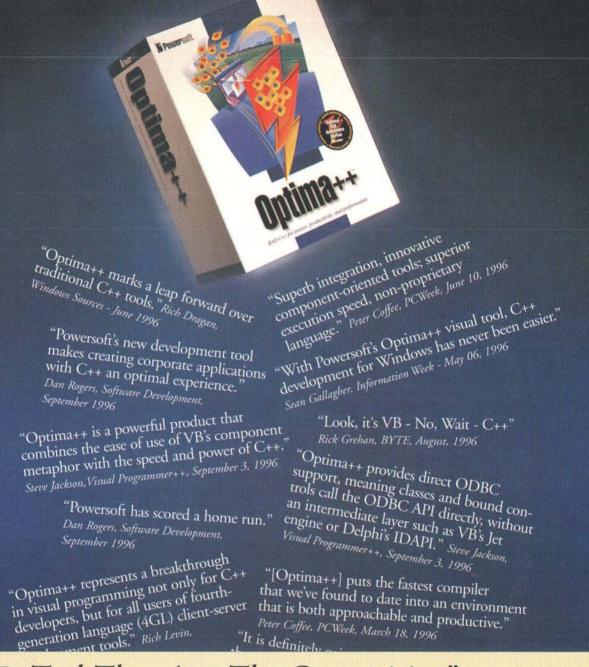


Smart cruise controls for cars could prevent drowsy drivers in the future from drifting out of their lane or driving too fast around a curve. To-

day's cruise-control systems let you set a preferred speed at which your car will travel, freeing you from the tedium of stepping on and off the accelerator on long drives. Researchers at the Robotics Institute at Carnegie Mellon University (Pittsburgh, PA) are working on next-generation systems that combine visual sensors and microprocessors. These intelligent systems will change speeds relative to the curvature of the road. They will also be able to warn you if you are not traveling in the correct lane and alert you to potential obstacles, even ones you can't see. Another possibility is maintaining a certain distance between your car and the one in front of you.

This is one of several new uses of robotics (for others, see this month's interview on page 48). Takeo Kanade, director of the Robotics Institute, says smart cruise-control systems should be ready in about two years. However, before they start showing up in cars of the twenty-first century, car manufacturers and the public will need to accept the concept.

-D.A.



"A RAD Tool That Aces The Competition"

Peter Coffee, PC Week, June 10, 1996

- · Component-based RAD C++
- Drag-and-drop programming
- · Over 220 components and classes
- Build and exploit Powersoft[®] DataWindows
- Native drivers for Sybase[®], Microsoff[®], Oracle[®], Informix[®], DB/2[®], and more
- Scalable Sybase* SQL Anywhere** database
- · Exceptionally tight, fast code
- Build and debug CGI, NSAPI and ISAPI custom application servers
- · Powersoft ObjectCycle for team development

Now you can deliver extraordinary solutions — at an extraordinary speed. Optima++™ revolutionizes development by allowing you to quickly build client/server and Internet applications using visual component assembly, drag-and-drop programming and the full power of C++.

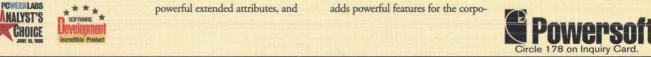
For client/server development, the new DataWindow[™] control gives you point-and-click database access, powerful extended attributes, and presentation capabilities made famous in PowerBuilder*. For Internet development, Optima++ delivers visual component assembly and seamless remote debugging so you can create high-performance applications and custom application servers.

Choose the edition that's right for you. Optima++ Developer delivers approachable C++ for client/server development. Optima++ Professional adds powerful features for the corporate developer including DataWindow technology and Internet development.

Optima++ Enterprise takes scalability and performance to the next level with native database drivers and

ObjectCycle[™] for team project management.

So don't just read about this revolutionary RAD tool. Order yours today and let Optima++ take your development to new heights!



Get Optima++ Developer, Professional, or Enterprise today: 1-800-395-3525 or www.powersoft.com

bits

its own brand of PCs built around the 6x86p. When asked if Cyrix would provide a chip that runs at full speed under NT 4.0 to customers who request one, Steve Tobak, vice president of marketing at Cyrix, said that it would offer a software fix if one is available. Or, he added, at the user's option, Cyrix will replace the chip.

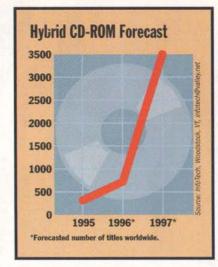
-Robert L. Hummel

CD-ROM Weds the Web

Although digital videodisc (DVD), the impending new CD-ROM standard, is currently attracting much attention, another important trend in optical storage is the marriage of the CD-ROM and the Internet's World Wide Web. Hybrid CD-ROMs are titles that include on-line communications, such as links to Internet sites where users can access expanded content. According to InfoTech (Woodstock, VT), a CD-ROM research and consulting firm, hybrid CD-ROMs are expected to account for nearly 10 percent of all CD-ROM titles in print worldwide by 1997.

Hybrid CD-ROMs have numerous advantages. A publisher can put highquality video clips on the CD-ROM, instead of making you squint at postagestamp-size, slow video as it transmits over the Internet. Game developers can establish links to Web sites that let you download gaming scenarios or participate in networked multiplayer sessions. Edutainment developers can create titles that have a link to an on-line interview. For example, a new title from the Graphix Zone (Irvine, CA, (800) 828-3838 or http://www.gzone.com/) called Herbie Hancock Presents Living Jazz includes links to an FTP site where you can download interviews with jazz greats to your hard drive.

Besides providing advantages to content developers, the emergence of the hybrids is also an opportunity for publishers of toolkits that make it easy to create such CD-ROMs. One such product is the WebCD development program, which is available from MarketScape (Colorado Springs, CO, (719) 593-9890 or http://www.marketscape.com). It does much of the work for you by helping you organize your Web content (for more information, see "Hybrid Web/CD-ROM:



The next big thing: CD-ROMs with on-line access.

Do It Yourself" on page 54). Companies such as Folio (Provo, UT, (801) 229-6700 or http://www.folio.com), whose customers access data stored in proprietary infobases, have introduced Internet-

enabled programs that leverage their core products.

For example, Folio says it will release a new version of its Web publisher that lets Internet users access information contained in Folio infobases. Folio's first Web publisher worked with only one HTTP server. Version 2, which should ship this fall, will run on HTTP servers from Netscape, Microsoft, and others.

Another version of Web publisher, which will follow version 2 and should ship late this year or in early 1997, will add some new features. They include support for document metering, rights management, and other functions currently supported in Folio, company officials say. Folio also provides tools for integrating disparate data stored in Folio infobases and Hypertext Markup Language (HTML) into a hybrid CD-ROM package. Says Ted Pine, chairman of InfoTech, "The Web will become the universal way to look at things, but the data you're browsing may originate from legacy databases."

Bug of the Month

Be Careful Out There!

This month's choice isn't a bug per se, but rather a dramatic example of what can happen when good people download bad ActiveX controls. Fred McLain, CEO of Apropos, a software engineering company, wrote an ActiveX control to illustrate the potential dangers in downloading ActiveX programs. If you're using the final version of

Microsoft's Internet Explorer 3 and download his Exploder control, it performs a clean shutdown of your Windows 95 system.

"I'm warning visitors to my Web page [http://www.halcyon .com/mclain/ActiveX]

that you have to be careful," McLain says. He points out that someone else could just as easily write an ActiveX control that formats your hard drive or does other equally bad things.

Exploder went through the Authenticode process, in which controls are submitted to VeriSign, the digital-authentication com-

pany that is working with Microsoft. With Authenticode, a software publisher signs its code with a unique digital signature, which confirms to users who published the control and that it hasn't been hacked.

Microsoft says Authenticode wasn't designed to guarantee that users won't download malicious code, but that the tech-

> nology does provide a measure of accountability on the Internet. McLain is not convinced that's enough.

> "If I were to put a loaded pistol on the table with a note indicating who owns the gun, that won't

prevent a 3-year-old from walking in, picking up the gun, and accidentally shooting himself," says McLain. "The note wasn't enough to prevent the accident." At press time, McLain was putting the final touches on a version of Exploder that does another clean shutdown, this time of Windows NT.

The Biboning Active X overal to display peopethy, you need to be nowing Microsoft Internet Explorated Windows 95.

To have 10 records to click the ActiveX central above.

To have 10 records to click the ActiveX central above.

Indicate the ActiveX central above.

Indica

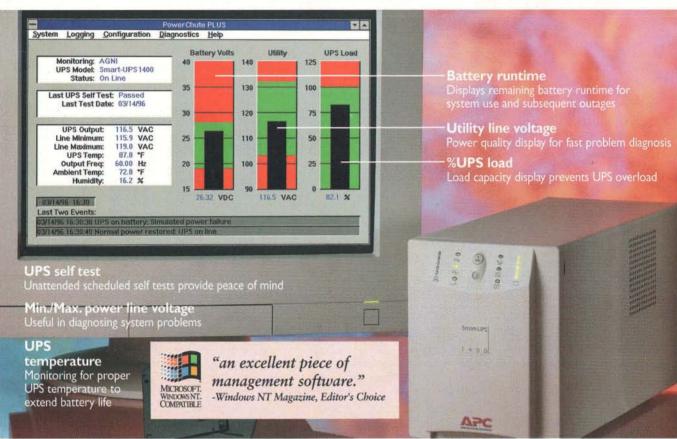
Exploder Test Page

This page is Microsoft Internet Explorer Hostile

-D. A.

Send yours to edejesusabix.com!

Introducing bulletproof glass for Windows™ NT networks



According to Microsoft, "A UPS is an important part of any deployment of Windows NT systems..." Fortunately, APC provides the most comprehen-

sive protection against the single largest cause of NT data loss-power problems. APC's PowerChute* plus for Windows NT and APC Smart-UPS combine to give you the power management features necessary to make SURE you're protected.

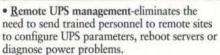
 Shut down system safely-graceful, unattended shutdown of Win NT & SMS Servers. Through scheduled shutdowns you can even cut energy costs by up to 76%.

• UPS testing/status-assures that system administrators are informed of power problems before they impact system integrity.

SURGEARRESTTM & PROTECT NETTM AC and dataline surge suppressors

BACK-UPS® & BACK-UPS® PRO

UPS for PC and advanced workstations



• Environmental/power monitoring-allows you to quickly diagnose power problems and thus decrease network downtime without the expense of an electrician. PowerChute plus also provides:

· NEW FlexEvents-Want to be paged or have an E-Mail sent to you if there is a power problem? FlexEvents allows you to specify these and other customizable UPS reactions to power events.

 Systems Management Servers UPS MIF Support permits asset management of UPS systems.

SMART-UPS® & SMART-UPS® V/S Manageable UPS for servers and networks

STARTING AT \$299

MATRIX-UPSTM & ACCESSORIES Modular UPS for client/ server datacenters



STARTING AT \$3499

*The Smart-UPS not only cuts the leading edge of power protection, its PowerChute plus software also delivers full management and control...[with] the best combination...of new and innovative features." -Network Computing













FREE **DEMO DISK** or 60 Page Catalog! or download from our

NEW PowerPage http://www.apcc.com Click on "Free Stuff"



AMERICAN POWER CONVERSION

800-800-4APC Dept. A2

Germany-(+49)89 958 235 France-(+33)05.39.32.03 UK-(+44)753 511022 India- (+91) 44 434 1784

Japan-(+81)03 3798 3888 Russia-(+7)095 929 9095 China-(+86) (10) 7638917

401-788-2797 fax / 800-347-FAXX PowerFax Literature Circle 129 on Inquiry Card.







STARTING AT \$119

Copyright 1996, APC. Trademarks are the property of their owners. ASU00.

just like everyone else's.

See what's possible

Introducing O2[™]. A workstation just as practical, reliable, and affordable as everyone else's. Except that it's better. Only O2 delivers industry-leading CPU and graphics performance as well as breakthrough video and imaging capabilities. All of this is possible because O2 is the only workstation in its class that is based on an innovative Unified Memory Architecture. In addition O2 is available with a MIPS® R5000[™] CPU, or, for your most demanding needs, the more powerful MIPS® R10000[™]. If you think all this makes O2 stand out, wait until you see how well it fits in. O2 is designed to easily plug into your network as well as leverage the interactive capabilities of the web.

It comes standard with a full set of web-authoring

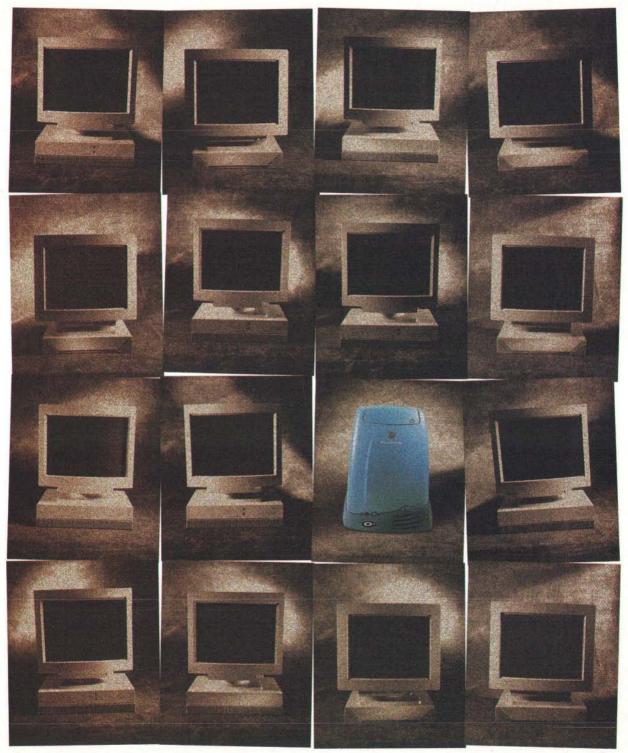
tools and a personal web server, a combination which allows you to communicate your ideas to anyone, anywhere, on any computer. If you're looking for the performance of a workstation combined with the power of the web, as you can

02 DESKTOP WORKSTATION \$7,495

MIPS R5000 180MHz processor
32-bit double-buffered graphics
Hardware texture mapping
Image processing engine
Video compression engine
Web-integrated user environment
64MB ECC SDRAM
2GB SCSI system disk
17" monitor, 1280x1040
100BaseTX/10BaseT Ethernet

see, it isn't hard to find. For more information see www.sgi.com/O2 or call 800.636.8184 Dept. LS0055.





© 1996 Silicon Graphics, Inc. All rights reserved. Silicon Graphics and the Silicon Graphics logo are registered trademarks, OI, and See what's possible are trademarks, of Silicon Graphics, Inc. MIPS and the MIPS RISC Certified Power logo are registered trademarks, and R10000 and R5000 are trademarks, of MIPS Technologies, Inc.

FlashPix: Future Graphics Lingua Franca?

It isn't often that a file format generates much excitement or offers much to end users, but the new FlashPix architecture may be the exception. Kodak created FlashPix, in collaboration with Hewlett-Packard, Live Picture, and Microsoft, to provide a better way for people to work with digital images. One important design goal of the FlashPix file format, which should now be available, is to let you work with large photographic images without requiring high-end computing power or bandwidth.

FlashPix meets this challenge in an ingenious way, based on the premise that most people don't need to work with all parts of an image at once. Images saved in the FlashPix format are automatically stored in a tiled format of 64 pixels per square. In this way, you can save images of any size, and when a FlashPix-optimized software program asks for data, only the specific tile or tiles requested are loaded into memory. The benefits of this approach: Photo editing is much faster because only the affected area is loaded into memory, and the changes are available almost instantly for the same reason.

FlashPix stores single images at multiple resolutions and enables applications to automatically choose the best resolution for a particular activity. You can thus access a smaller low-resolution image for an on-line preview and then download a bigger high-resolution copy of the image. This should eliminate the long waits currently associated with viewing high-quality graphics on the Web.

Another big plus is FlashPix's ability to save edits as a linked file, which can reduce storage requirements, especially for graphic artists who often save multiple versions of the same image. You can link edits to an original file but store the edits separately, thus eliminating the need to store multiple versions of the entire file.

At press time, there was only one program, Microsoft's Picture It, an image-editing application, that supported Flash-Pix. Software Development Kits (SDKs) for writing Windows and Mac FlashPix applications should now be available.

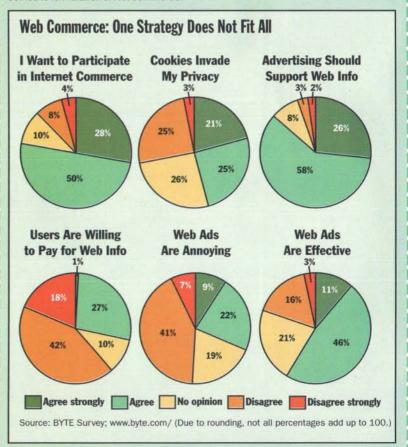
Survey

Web-Commerce Polarization

This month's BYTE survey on Internet commerce and privacy reveals a sharp difference of opinion regarding how much privacy users are willing to give up in exchange for access to free information. The topic of cookies is an especially tricky one. Cookies, small pieces of code that are stored on an end user's computer, let a Web server automatically grant visitors access to areas to which they are specifically entitled. Paid subscribers can automatically access value-added information, for example, but Web masters can use cookies to track your activity on their sites in a detailed way.

This tracking capability makes users nervous. "Commercial sites have every right to monitor your actions within the spectrum of their site," says one respondent. "But they should not have the right to distribute that information to others." Another says, "Use of tracking data aggregated to eliminate individual identity is OK, but using individuals' data is too great an invasion."

Other respondents favored the use of advertiser-supported free information. Also, if faster links to the Internet become prevalent, letting ads come up more quickly in a Web browser, that may reduce complaints against on-line ads. What's the answer? Probably a mixture of strategies. As one respondent says, "I guess we live in interesting times when it comes to formulation of Net commerce."



Several vendors may incorporate Flash-Pix into scanners, printers, and digital cameras. Microsoft says that it will incorporate FlashPix into its Internet Explorer Web browser.

However, not everyone has endorsed FlashPix. One notable company that had

not committed to the format as of press time was Adobe. Kodak officials say they will continue to discuss FlashPix with Adobe and others. If the standard is successful, FlashPix could make digital imaging easier, faster, and more fun.

-Jon Pepper

get DOIL & GIGK IVE CATA Solutions On the Web

Introducing NEW IntraBuilder™—the quickest, easiest way to transform your data into interactive information on your Intranet. Automated Experts guide you through every step of creating your data solutions with point & click ease. Plus, IntraBuilder's powerful, productivity-boosting visual tools make it easy for you to switch back and forth between working in the visual designers and the underlying JavaScript™ code. IntraBuilder Professional comes with Netscape Navigator™ Gold, Netscape FastTrack™ Server, and prebuilt business solutions, making it the only complete Intranet solution.

IntraBuilder supports all local and SQL database standards, so you can use your existing data. And with support for Windows 95 and Windows NT, Java™ applets, ActiveX controls, and industry-standard Web servers and browsers from Netscape and Microsoft, IntraBuilder bridges the industry standards gap.

Discover the fastest, easiest way to develop your live data solutions on the Web.

To find out more, call 1-800-336-6464 or visit our Web site and download the free evaluation copy at WWW.borland.com/intrabuilder20/

Borland

Making Development Easier

Call your local reseller

CDW 1-800-334-4CDW

Point & click live data

Software Spectrum 1-800-787-1166

N 01-

Stream International 1-800-699-1736 Programmer's Paradise 1-800-445-7899

Circle 138 on Inquiry Card.



Java Forms: Better than HTML

Now that forms vendors have tackled the Common Gateway Interface (CGI) problem, they are addressing the next step in Internet forms software, the incorporation of Java. Vendors such as JetForm (http://www.jetform.com) and Caere (http://www.caere.com) have introduced products that let developers create—without having to learn CGI programming—forms solutions that can integrate with databases for electronic-commerce and work-flow applications.

However, the current solutions have trade-offs. You can let an end user fill out a Hypertext Markup Language (HTML) form using any Web browser, but HTML doesn't let you preserve the exact look of a paper-based form. Or, users can fill in a non-HTML form that has added intelligence (e.g., field validation and error checking at the client) and a more robust look, but that requires them to download a proprietary filler product such as Jet-Form Filler for the Web. This is where Java can save the day.

JetForm, which acquired Delrina's forms and work-flow technology from Symantec, is about to enter beta testing on an upgrade to its forms designer, which will soon emit a Java applet. According to Michael Cohen of Paperless Performance (http://www.paperless .com), a developer of electronic-forms solutions, Java support lets you have the best of both worlds. You can view forms in any Java-compliant Web browser, and, unlike HTML forms, the Java applet can have field-level intelligence and help, and also be an exact replica of a paper-based form. Field-level intelligence lets a form catch user-input errors before erroneous data is sent to a server. "And providing an exact replication of the paper form that may be used today makes people, especially computer novices, more comfortable when filling in the electronic form," says Cohen.

JetForm admits that the initial version of its Java solution will not have the full functionality of its JetForm Filler. For example, the initial Java implementation probably will not support database lookups. But JetForm officials say they will continue to improve their Java story.

Book Reviews

What Was the Question?

The most obvious problem with this collection of nine essays on the frame problem in Al is that it does not tell you exactly what the frame problem is. Your best bet is to read the epilogue first. This pseudo-Mother Goose—style section is probably intended as an inside joke by the cognoscenti, but it's actually more helpful than the rest of the book.

As I understand it (and if I'm wrong, write to Ford and Pylyshyn, not me), the frame problem involves how much information you need to give a robot (or a computer) for it to perform a task as well as a human would. For example, when frying an egg, do robots need to know what to do when the egg carton is empty? What about when the frying pan used yesterday still sits in the sink, unwashed?

Other descriptions of the frame problem include "describing and updating a set of beliefs efficiently" and (my favorite) "Now what do I do?," which almost any reader of this book can say at anytime. Clearly, the folks who work on the frame problem have



a hard time agreeing on exactly what it is. Furthermore, it overlaps many subject areas, including psychology, ethics, philosophy, and religion.

Reading this book is tough work. The authors do not adequately define words

such as metaphrands, metaphiers, and Quineian, as well as references to concepts such as Yale shooting. The book lacks a glossary and provides a mere one-page index of topics. One particular essay, a poorly written science fiction story containing profanity and spelling and grammatical errors, illustrates the book's low level of editing.

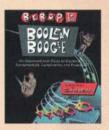
I would recommend this book highly for anyone whose essay is published in it. For the rest of us, any robot story by Isaac Asimov or Stanislaw Lem will tell us morein a more lucid and entertaining manner about the difficulties of designing thinking machines. Now what do I do?

-Edmund X. DeJesus

Deluxe Digital-Electronics Primer

aving picked up digital electronics on my own, I've always looked for a book that could fill in the holes in my piecemeal self-education. This is it. With clear explanations, many effective figures, and typical

British humor, Clive Maxfield surveys not only the basics of computer electronics, but also state-ofthe-art semiconductor fabrication and packaging techniques. I am



happily amazed that Maxfield covers so much, so well. Four hundred plus pages on electronics have never gone so fast.

The humor that peppers the introduction, footnotes, and appendixes (especially the last one, a seafood gumbo recipe) makes for easy reading, but the content is serious, well researched, and up-to-date. It starts with just enough basics from chemistry, physics, and number systems to get you to the workings of semiconductors and simple logic circuits. From there, the book covers tools such as Boolean algebra, Karnaugh maps, and state diagrams that circuit designers use to build more complex logic from basic gates.

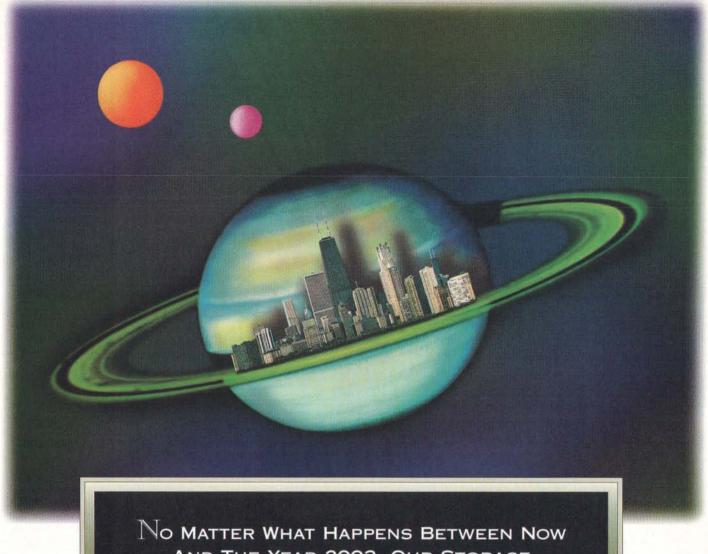
The book then switches gears to discuss semiconductor fabrication processes, the design of memory and programmable logic devices (PLDs), a bestiary of ASICs, packaging strategies (including multichip modules), and promising fabrication technologies such as 3-D interconnect. That the author obviously hand-edited the glossary and comprehensive index is a sign of the quality throughout. Books of this caliber are rare.

—Dave Rowell

The Robot's Dilemma Revisited: The Frame Problem in Artificial Intelligence

Edited by Kenneth M. Ford and Zenon W. Pylyshyn, Ablex Publishing Corp., 141 pages, ISBN 1-56750-143-5, \$22.95 Bebop to the Boolean Boogie (An Unconventional Guide to Electronic Fundamentals, Components, and Processes)

by Clive Maxfield, High Text Publishers, 471 pages, ISBN 1-878707-22-1, \$35



AND THE YEAR 2003, OUR STORAGE ENCLOSURES WILL STILL BE UNDER WARRANTY.

Cell phone implants? Intergalactic zoning laws? There's no telling what the next seven years could bring. But one thing's for sure: Your Kingston®

storage enclosures will still be under warranty. These rugged and reliable storage systems were designed for some of the most demanding environments—even the space shuttle. Plus, we offer the longest warranty in the industry. The Kingston Data Silo® DS500 tower or rackmount enclosure can house 3.5-inch and 5.25-inch halfor full-height SCSI peripheral devices. Our Data Express® removable drive enclosures, integrated into our DS500 chassis, provide a variety of

customized enclosures for up to 12 removable, hotswappable SCSI devices. Of course, Kingston storage products are compatible with all major platforms. Want more information? Give us a call at (800) 435-0670, or you can send us e-mail at

storage@kingston.com.

For more information, call us at (800) 435-0670 (500)



Visit our Web site: http://www.kingston.com/b.htm

check Olli-

data. Calm

Check out the new web site from Data Communications

www.data.com



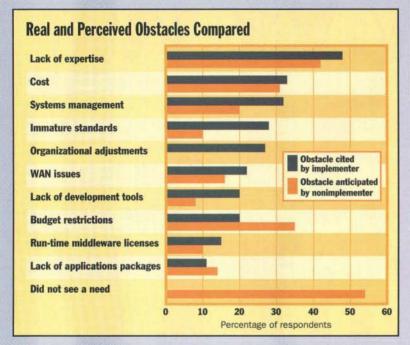
Datapro Report

Wanted: Client/Server Expertise

igh costs and lack of expertise and systems management are the major obstacles on the way to realizing the benefits of client/server computing, according to Datapro's 1996 International Client/Server Issues Survey. Information systems executives understand the cost implications of client/server computing, realizing that, despite the conventional wisdom of the early 1990s, expenditures may be even higher

schemes. Additionally, about 75 percent of them incorporated legacy systems, and about one-third of those incorporated legacy systems through real-time connections, as opposed to gateways or batch data transfer.

As you can see in the chart, the perceived disadvantages of client/server computing among those who haven't implemented a system differ—in some cases by a large mar-



Those not implementing a client/server system underestimate the obstacles of management and immature standards.

than those of a monolithic system. However, they also believe that the benefits outweigh the cost and other disadvantages.

Implementers said the top benefits are improved end-user access to information, the ability to flexibly react to business needs, and scalability (i.e., the ability to add additional capacity).

As expected, the trend line for full implementation of a client/server system continues strongly upward. In 1994, 18 percent of the respondents to Datapro's survey had fully implemented a client/server system. By 1995, that number increased to 25 percent, and this year, it was up to 46 percent. Of the implementers, half use a two-tier scheme, but a third use multiple-tier

gin-from the disadvantages as stated by those who have completed their systems. Nonimplementers seem to have less awareness of the pitfalls of immature standards, system management, and the lack of development tools compared to those who have already implemented a client/server system. Of this year's respondents, 29 percent are still making client/server plans. Those who are still in the planning process might want to reevaluate how many resources they plan to devote to trouble areas such as systems management and immature standards. Dennis Byron is a senior analyst for Datapro Information Services. For more information on Datapro Information Services: (800) 328-2776, (609) 764-0100, or http://www.datapro.com.

Notebook Screen Future: Bigger and Wider

Major suppliers of LCD panels—including Sharp, NEC, and Mitsubishi—are developing displays that are larger and more advanced than today's 12.1-inch thin-film-transistor (TFT) standard. Sharp's new Super-V LCD, currently available only as a 13.8-inch prototype TFT model, has 1024- by 768-pixel resolution, a 140-degree viewing angle, an ultrahigh brightness-to-darkness contrast ratio (300-to-1), and a viewable image area roughly equivalent to that of a 16-inch CRT.

Although Sharp is not shipping this model yet, its PC-9090 notebook, due for delivery by the end of the year, will include some of its aspects. The PC-9090 uses a Super High Aperture 12.1-inch TFT with 1024- by 768-pixel resolution and brightness Sharp claims is 50 percent higher than previous models.

Sharp ((800) 237-4277 or http://www .sharp-usa.com) also just released the first wide-screen notebook, the 4.6-pound WideNote portable. Its 9.6- by 5.6-inch display (see the photo) can show two side-by-side Web pages or a standard-



Sharp's WideNote display reduces the need to scroll through spreadsheets.

width letter with extra space left over on the side. The 16-to-9 aspect ratio is the same as a movie screen. The wide-screen LCD has a resolution of 1024 by 600 pixels and a diagonal measurement of 11.28 inches.

NEC and Mitsubishi (among others) are currently working on LCD screens bigger than 13 inches, and NEC has

Compex FreedomSwitch

When workgroup traffic has completely **changed**, the entire network needs **re-balancing**.



It only takes a second.

The Compex FreedomSwitch is not a typical Ethernet switch. It is not a port matrix or port switch. Neither is it just a repeater. In fact, it is all of the above and more. Tailored to boost your network performance, the 24-port FreedomSwitch uses an exclusive AutoDynamic Load Balancing technology to seamlessly balance the load of your network by dynamically assigning and reassigning ports to one of four 10Base-T network segments. Simply plug in the workstations and servers, turn on the power and you have an optimized, switched network. It also includes complete network analysis and management, with

full implementation of RMON and an optional 100Mbps uplink. So you don't need to get your hands full managing your network. Just kick back and relax.

For an affordable switched network that anyone can set up and operate, choose Compex. Call us for more information about the new FreedomSwitch or browse our website at http://www.cpx.com.

Networks that work



the snappable,
16-port Compex MicroHub
Plus 100/TX16

U.S.A. COMPEX, Inc. 4051E. La Palma Ave Anaheim, CA 92807 U.S.A. (714) 630 7302 Fax (714) 630 6521 GERMANY

ReadyLINK Networktechnology GmbH

Albert-Einstein-Straße 42

63322 Rodermark, Germany

(49) 607 4 98017

Fax (49) 607 4 90668

SINGAPORE
COMPEX Systems Pte Ltd
135 Joo Seng Road,
Singapore 368 368
(65) 288 8220
FAX (65) 280 9947

Circle 701 on Inquiry Card (RESELLERS: 702).

bits

demonstrated 20- and 26-inch panels in Japan. While those are not intended for use in a notebook (such screens are wider than today's standard laptop size), analysts expect the 13.8-inch size to appear in notebooks toward the end of 1997. Today's 12.1-inch display that seems large will soon look as outmoded as 10.4-inch displays do now.

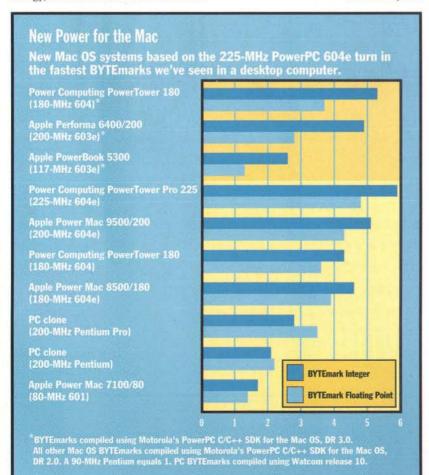
New PowerPCs Boost Macs

Results from BYTE's cross-platform BYTEmark benchmark indicate that the latest PowerPC-based Macs give users a significant performance boost. As we expected, Power Computing's Power-Tower Pro 225 is the fastest Mac we have tested, in terms of its raw processing power. Indeed, its BYTEmark scores are the highest we've seen in a single-processor desktop system.

Due to differences in compiler technology, a careful reader will notice that the results shown here for certain processors (e.g., the 200-MHz 603e) differ from the results we posted in our August issue. This is because we used different compilers to compile the BYTEmark suite for Windows NT and the Mac OS. Improvements in compiler technology can also improve performance on the same chip. For example, the 180-MHz 604 gets a big boost in integer performance when executing BYTEmarks that were compiled by release 3.0 of Motorola's PowerPC Software Development Kit (SDK)—see "New Power for the Mac" below—compared to release 2.0.

IBM and Motorola are preparing new PowerPC processors (code-named G3) for 1997. These will be based on the 603e and 604e, but with bigger caches and better system interfaces. Another generation will follow in 1998 (for more information on the PowerPC road map, see the article "PowerPC Regroups" on page 101). The much-delayed PowerPC 620 may finally ship within the next three or four months, as well.

-Tom Thompson



cd-rom review

Architecture Bible on CD-ROM

Moving a venerable reference book onto a CD-ROM can be either a waste of plastic or a huge step forward in terms of usefulness. You hope that such a transposi-



An architectural reference bible is now available on CD-ROM.

tion increases the convenience, searchability, and portability of the material.

John Wiley and Sons has put the entire contents of Architectural Graphic Standards, a reference bible for architects since 1932, on CD-ROM. The disc defines and explains structural, mechanical, and electrical systems with text and technical diagrams. You can search it by several methods, including standard text searching and an index.

A potentially great feature of a CD-ROM like this is the ability to use its included diagrams in your drawings. However, only 10 percent of the diagrams on this version are in accurate vector format.

The interface is intuitive, although navigation is difficult because it is hard to retrace your steps. You can export whole illustrations or parts of them into your word processing or graphics programs, but you cannot cut and paste from this program. Currently, tables and equations found in the CD-ROM are not interactive, but they will be in a future version (slated to ship in about a year and a half).

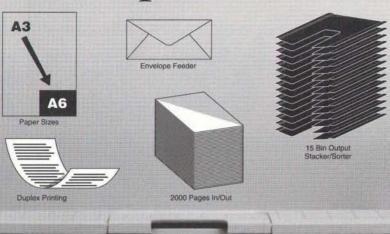
John Wiley and Sons has not created a perfect transition of *Architectural Graphic Standards* from one medium to another. However, it is an important beginning that hints at exciting possibilities.

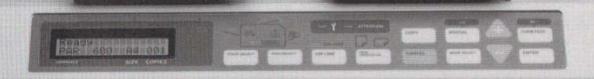
-Jason Kraus

Architectural Graphics Standards

John Wiley and Sons, 605 Third Ave., New York, NY 10158, (800) 225-5945, http://www.wiley.com, \$345

Kyocera printers maximise your options







- And cost you less. Work it out for yourself

The widest choice of paper-handling attachments in the industry, transferable between different models, means Kyocera page printers maximise your printing options. You can, for instance, choose two additional input trays, a duplex (double-sided) unit, an envelope feeder and output to a 15-bin sorter/stacker. Kyocera printers also give you the lowest cost of ownership.

Get your FREE pack



These and many other benefits are the reasons why major corporations are choosing Kyocera.

Make sure you have the full facts. Send for your free information pack: "Evaluating Your Printing Needs". Just fill in the coupon and send it to the address below.

NAME POSITION

COMPANY

ADDRESS

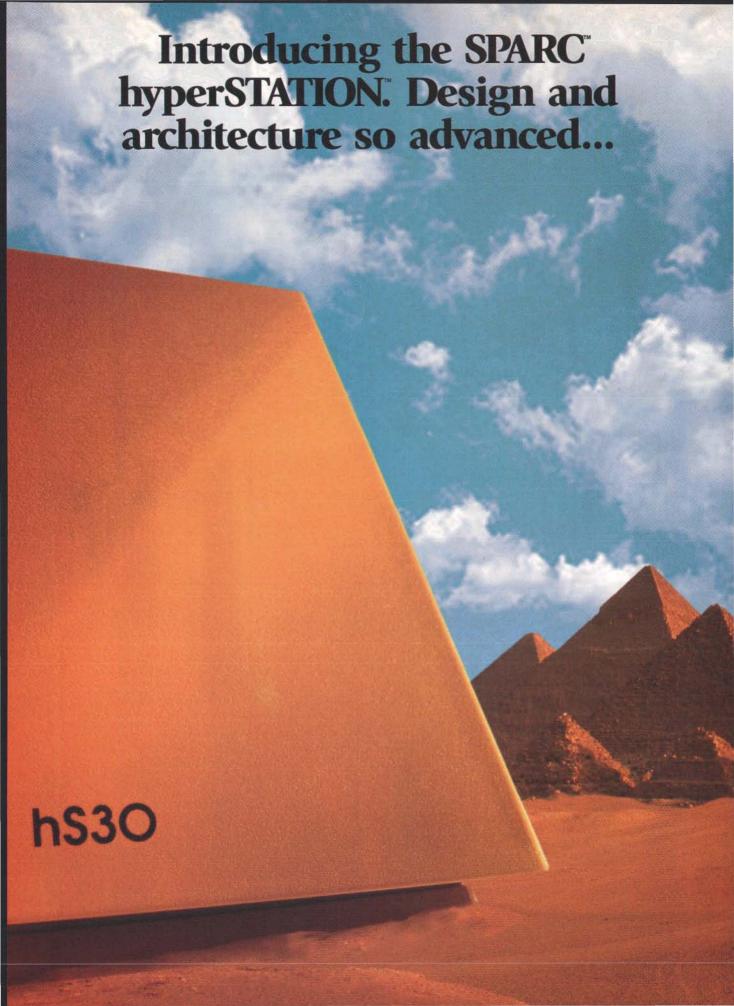
TEL

FAX

Kyocera Electronics Europe GmbH, Export Division, Mollsfeld 12, 40670 Meerbusch, Germany Tel: **49-2159-918-0

KYOCERa A generation ahead

Fax: **49-2159-918108 Circle 734 on Inquiry Card (RESELLERS: 735).



years from now, you'll still marvel at your applications' monumental performance.

THE SUNOS® AND SOLARIS® SOLUTION.

Just because the Sun is setting on your current operating system, it doesn't mean you're left in the dark. ROSS, the sole supplier of hyperSPARC™ CPUs to the SPARC market worldwide, creates hyperSTATION 20 and hyperSTATION 30-the dawn of a brand new day in SPARC workstation performance. Today, you can have the power you need to run SunOS 4.1.3 SunOS 4.1.4, and Solaris applications at speeds faster than you'd ever imagined possible. And you have the power to maintain that edge in the future.

THE LONG-TERM SOLUTION.

Our high performance SPARC microprocessor architecture is housed in a new chassis specifically designed for future generations of exactly what ROSS is famous for... multiprocessor upgrades. Shining examples of ROSS' forward-thinking approach, both hyperSTATIONs feature an advanced thermal management system, a stronger power supply, options for a 6X CD-ROM drive, 24-bit 2-D and

INTRODUCING THE

HYPERSTATION 20 AND 30.

HYPERSTATION 20. MORE SPARC FOR YOUR BUCK.

hyperSTATION 20 has more features than Sun's SPARCstation 20 for a lot less money. Dual 50 MHz MBus slots support up to four hyperSPARC processors and up to 512MB of RAM, so you can pick the level of speed you need. And with our 6X CD-ROM drive, ISDN and high performance graphic accelerator options, the hyperSTATION 20 gives you features the competition doesn't even offer.

HYPERSTATION 30. THE MASTER OF SPARCS.

hyperSTATION 30 is as fast as it gets. It features a new 66 MHz MBus for high-throughput multiprocessing and a 1GB physical system memory for advanced ECAD and database applications. Combine our current microprocessor speeds from 133 to 166 MHz and ROSS' evolutionary history of advanced hyperSPARC performance, and you'll start-and stayon the fast track.

3-D graphics accelerator, and enough real estate for up to 6GB of hard disk space.

EXTENSIBLE, UPGRADEABLE, CONNECTABLE, RATIONAL AND AFFORDABLE.

You can always extend your performance level with our high speed single, dual- or quadprocessor upgrades. And you can rest assured that our SPARCbased and UNIX-compliant open systems solutions will provide high connectability. When you think about it, ROSS hyperSTATIONs are the only way to go if you want to put your company's future on a predictable path for growth-without buying into the high costs and inevitable headaches of moving to alternative platforms.

OTHER MARVELS OF ROSS TECHNOLOGY.

If you're in the market for memory, motherboard upgrades or microprocessor upgrades, from 90 to 166 MHz, we have them. Call us today for specifications and prices!

CALL 800-ROSS-YES.



CALL 800.ROSS.YES

5316 Highway 290 West Austin, Texas 78735 800.ROSS.YES International 512.349.3108 FAX 512.349.3101

bits

Blasts from the Past



The industry was in transition. Apple and IBM were working together, as were IBM and Microsoft, despite their recent public divorce. More details on a new OS called Windows NT began emerging. Sales of Windows 3.0 were encroaching the Mac, but Novell was still pushing DR DOS. Meanwhile, we put the ill-fated Momenta computer on the cover. Pen-based computing hasn't yet broken into computing's mainstream, and Momenta Corp.'s eventual collapse is a good analogy for the eventual fate of many of the pen-based start-ups. A stronger trend that we devoted coverage to in that issue: network interoperability.



BYTE took an early look at Compaq's Deskpro 386, which started at about \$6500. We also reviewed the Mac Plus, which upped the Mac's memory from 128 KB to 1 MB and increased the floppy drive from 400 to 800 KB, among other things. Also in that issue: scads of information on knowledge representation.



We focused on data management and the problems thereof. Other articles focused



on how to use the microcomputer as a laboratory instrument and a hardware product from Microsoft called the Softcard. This was a \$399 board

that allowed you to run programs and languages written for CP/M on your Apple computer.

Beyond R2D2: Robots Evolve

Takeo Kanade, director of the Robotics Institute at Carnegie Mellon University, reveals how robots will make our world better and more entertaining.



BYTE: Robots are showing up in new places and in new forms. What interesting new uses are you exploring for robots? Kanade: The scope of where robots are used has been and will be expanded from the factory floor to more "natural" environments, including agricultural fields, mines, and construction sites. We are also looking at space and planetary exploration and other hazardous environments, including natural environments such as volcanoes and those of human origin, such as nuclear environments.

BYTE: Your robots have explored volcanoes to gather data. What other tasks can robots do that humans currently must perform at great risk?

Kanade: Another one that we are working on is a helicopter project, a flying robot. This has an advantage when rescuing people in bad weather or fire fighting. In bad weather, for example, a ship sinks and survivors are expected. The first thing is to try to find them. But the rescue mission may be put on hold in bad weather because the rescuers would also be in danger. Now if this is an unmanned mission, we can risk a helicopter crash. On all these dangerous missions, the key factor is, the more risk you take, the more effective is the mission. If you can do a task in such a way that even a crash is aceptable, the effectiveness grows rapidly.

BYTE: A robot helicopter could help fight fires, too?

Kanade: Yes, and again, the more effective the mission, the more dangerous. If you hit the hottest spot with a fire-fighting agent, it's very effective. But it's also dangerous. So human pilots don't fly that close. But a robot-powered airplane can accomplish dangerous missions without risking human life.

BYTE: What about robots and entertainment?

Kanade: That's a new breed of robotics, what is called virtualized reality. We have built a 51-camera dome that we call 3-D Dome. It's a 5-meter dome where the cameras are looking inside. In other words, the dome space is covered by a sea of cameras. And whatever happens inside is modeled into a CAD model. It's a natural event. So imagine that you are inside the dome, and you swing a baseball bat. How your shirt, body, and hand move are modeled into the computer. Because it is modeled, we call it virtualized reality. Once we do that, we can place you in that environment anyway you want. Thanks to the 3-D models, you can actually immerse yourself into that environment. One of the best applications that I envision is watching NBA basketball on the court.

BYTE: So this would let you watch the game from the referee's point of view? Kanade: Or from anywhere inside the court. You could see what it's like blocking Michael Jordan. Or you can enjoy the view that the ball would see, if it could see.

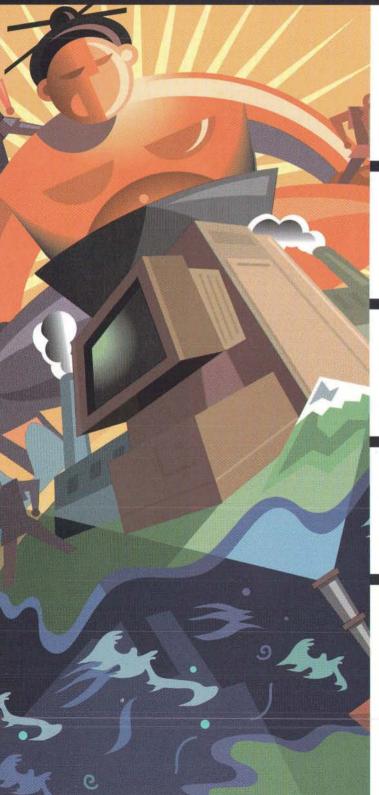
BYTE: What about using robots to manage data?

Kanade: We have an infomedia project that lets you navigate in a large video database very quickly by using natural language as a query. The important viewpoint I would like to convey is that robotics is not limited to mechanical things.

For more information on the Robotics Institute, see http://www.ri.cmu.edu.

BYTRA

INTERNATIONAL



Special Delivery

European homes can now get software via digital satellite. Page 48IS 3

The Surging CTI Tide

Low-cost CT servers are replacing your PBX. Page 48IS 7

ATM Hits the Desktop

Corporate interest in ATM-based LANs is growing. Page 48IS 17

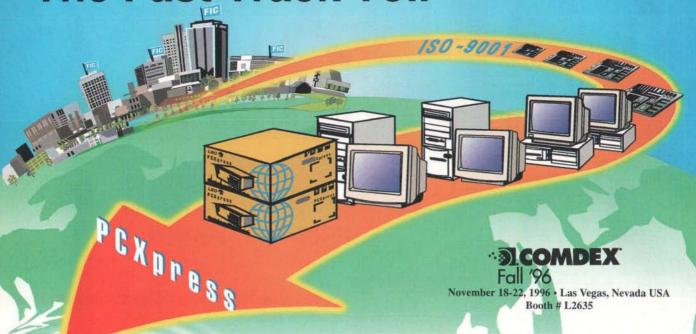
The Rise of Asian PCs

More powerful PCs from Asia. Page 48IS 25

Data Mining for the Rest of Us

Finally, an easy-to-use datamining tool. Page 48IS 33

The Fast Track To...



Increasing Your PC Systems Business

Deliver the hottest new systems to your markets with PCXpress, a complete range of high-quality, leading-edge systems designed and built to your requirements by FIC, the world's leading motherboard manufacturer.



Convenient System Upgrades

For maximum flexibility, PCXpress systems run all the latest processors from Intel, AMD & Cyrix. Pipeline Burst SRAM plus EDO and Burst EDO DRAM support adds further versatility and performance.



Efficient, High-Volume Manufacturing **Facilities**

Mainboard manufacturing and barebone system assembly are carried out in FIC's efficient, high-volume ISO 9001-certified facilities in Taiwan and China using advanced SMT and AI machinery.



Wide Selection of High-Quality Peripherals

With our global buying power, FIC brings you the best possible pricing for a complete range of peripherals and multimedia add-ons -allowing you to easily differentiate your systems in the market.



Localized Build-to-Order Services

With their sophisticated distribution system and efficient assembly operations, FIC's facilities in the USA, Europe, Australia, and Hong Kong ensure your systems arrive ontime to market.



Cutting-Edge R&D Capabilities

With our state-of-the-art R&D facilities, FIC is a world leader in the development of cutting-edge motherboards and PCs-giving you the products you need to succeed in even the most competitive markets.



The Highest Quality At the Best Prices

FIC's sophisticated vertical integration program and our high-volume purchasing power guarantee you the lowest possible prices for high-quality system components. Close ties with the world's leading component suppliers ensure guaranteed deliveries even in times of shortage.





6F, FORMOSA PLASTICS REAR BUILDING 201, TUNG HWA NORTH ROAD. TAIPEL TAIWAN Tel: 886-2-7174500 Fax: 886-2-7182782 http:/www.fic.com.tw/

FIC EUROPE B.V. FIC AUSTRALIA

Tel: 61-2-7484566

Tel: 1-510-2527777 Fax: 1-510-2528888 Tel: 31-73-6273300 Fax: 31-73-6231412 Fax: 61-2-7484633

FIC FRANCE FIC SPAIN FIC HK FIC JAPAN

Tel: 33-1-46810203 Tel: 34-1-6373613 Tel: 852-2-3453599 Tel: 81-3-5461-2181

Fax: 33-1-45739885 Fax: 34-1-6373863 Fax: 852-2-7972408 Fax: 81-3-5461-2345

FIC CZECH REPUBLIC Tel:42-5-41122643 Fax: 42-5-41213144 Specification subject to change without notice. All trademarks used herein are the registered property of their respective owners.



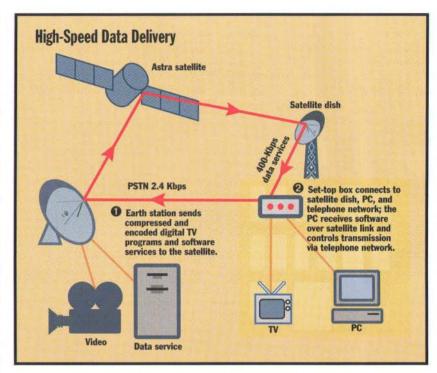
Software via Digital Satellite TV

Digital satellite TV brings broadband software services to Europe's homes.

C users in France are the first in Europe to receive commercially available highspeed data services from digital TV satellites. Europe's biggest pay TV provider, Canal + in Paris, launched direct-to-home software-downloading services earlier this year. On its C: channel, a program that focuses on computer news and reports, the company offers its C:Direct service. This lets PC users download shareware, games, educational software, and benchmarking databases at 400 Kbps.

The set-top box connects to the satellite dish, the PC's parallel port, and the telephone network. You need no additional software. To trigger and control the download, the set-top box starts the transmission via telephone and receives the software in high speed over the satellite dish. The return path's bandwidth, however, is only 2.4 Kbps, but higher speeds on the return path will soon be available as an option, Canal+ says. By the end of the year, Canal + plans to have a commercial software store in place offering graphical and musical applications as well as office tools and Internet access over satellite.

The company provides the navigation and terminal software for the download, but payment will be handled by remote control and the TV's electronic program guide. Customers can use a credit card or have the charge posted in their monthly



Satellite TV services will reach homes in France, Spain, Italy, Belgium, and Germany.

Canal + bill. In both cases, transactions will be processed over the telephone line.

Canal+ reckons that C:Direct subscribers will number more than 15,000 by the end of this year. The company is expected to expand the service next year to Spain, Italy, Belgium, and Germany. However, elsewhere in Europe, competition will be fierce. The German Kirch group's DF1 digital satellite TV service announced that it will offer similar services at the beginning of 1997, and pay TV group Nethold is considering interactive PC services for its digital satellite TV subscribers in the Netherlands and Scandinavia.

Today, only the downstream path of digital satellite TV services are really "on the air," and the control path runs over telephone lines, but industry experts expect bidirectional services to appear after 1998, when the Astra satellite consortium will have launched a new generation of satellites. The new systems will include transponders capable of handling bidirectional Ka-band services.

- Adele Hars

More Bandwidth, More Time on the Internet

Although cable TV networks in continental Europe tend to be based on one-way coaxial cabling that can't be deployed in interactive services, results of the first European commercially available interactive service over cable are surprising. "Ninety-eight percent of residential users of our Cybercable service

use the Internet," says Pierre Bouriez, development director of Lyonaise Communications in Paris, France's largest cable TV provider. He adds: "They log on for an hour and 40 minutes every day, as opposed to the 10 hours per month the typical Internet user spends over telephone lines."

Toshiba's First **Desktop PC**

Targeted at home users, Infinia includes many ease-of-use features

The world's leading notebook maker entered the hotly contested home PC market in mid-September with a vengeance. Geared to the home user, Toshiba's Infinia line boasts respectable PC components that are combined with consumer-electronic enhancements in an appealing design at competitive prices.

"It's a start," says Gary Elsasser, senior director of product planning for the worldwide computer systems group.

Each Infinia has a well-thought-out LCD (LED on two models) panel that provides one-touch access for checking telephone messages, making a phone call, playing an audio CD, or tuning into TV or FM radio.



Toshiba Infinia home PC.

(A TV/FM radio capture card comes standard on the top-of-the-line Model 7200, and a remote-control device lets you access entertainment features from anywhere in the room.) Intel supplies the ATX motherboards that have two universal serial bus (USB) ports and, depending on the model, a 200-, 166, or 133-MHz Pentium processor. A digital-videodisc (DVD) drive upgrade kit costing between \$600 and \$700

will be available soon, as well as a camera and software for videoconferencing. The bundled software will include several leading packages, including Windows 95, Microsoft Works, Quicken SE, Microsoft Encarta 96 Encyclopedia, and, of course, the two leading Internet browsers.

Toshiba is waiting until the CeBIT show in Hannover, Germany, in March to introduce its Infinia PCs in Europe, though the European versions will be upgraded models from those now selling in the U.S. Toshiba also plans to launch a line of PCs for business users in early 1997 and a line of servers the following year.

- Rich Friedman

Convert Windows 95 Languages

If you download a Web site in Chinese or another Asian language, you'll often get garble. In most cases, you will need an encoding/decoding utility program to convert this mishmash into a readable format. But many of the available programs support only one Asian language.

DynaLabs in Taipei is shipping a program that supports Japanese, Korean, and both traditional and simplified Chinese. Later this year, it will show Global Surf, an encoding/decoding program that supports all languages running under Windows 95-more than 23 at last count, according to Derek Chou, sales manager.

DynaLabs' Asian-language program, AsiaSurf, is a utility that runs on top of several language versions of Windows 3.1 or Windows 95, including Chinese, Japanese, Korean, and English. Thus, you don't need a Chinese version of Windows 95 to decode text, Chou says. AsiaSurf can also access on-line information, e-mail, and the Internet in these languages. The program can run under Netscape's Navigator and Microsoft's Internet Explorer, It supports cc:Mail and Microsoft Mail.

It is simple to operate AsiaSurf: Download a Web page. On the screen, you'll find national flags from China, Japan, South Korea, and Taiwan. Simply point and click on one of these four flags, and the garble is converted into that language. The company offers a free 20-day trial. To download AsiaSurf, simply call up http://www .dynalab.com/. - Mark LaPedus

	Infinia Home	Home PC Product Specs	
	Model 7200	Model 7160	Model 7130
PROCESSOR			
CPU	Pentium	Pentium	Pentium
Cleakenend	00001414-	100 MH-	122 MLI-

PROCESSOR			
CPU	Pentium	Pentium	Pentium
Clock speed	200 MHz	166 MHz	133 MHz
L2 cache	256-KB write-back pipeline burst SRAM	256-KB write-back pipeline burst SRAM	256-KB write-back pipeline burst SRAM
MEMORY			
Standard RAM	32 MB of EDO DRAM	16 MB of EDO DRAM	16 MB of EDO DRAM
Maximum RAM	128 MB	128 MB	128 MB
3%-INCH ENHANCED IDE	HDD		
Capacity	3 GB	1.9 GB	1.5 GB
	(3.1 million bytes)	(2 million bytes)	(1.6 million bytes)
USERINTERFACE			
	InTouch module with	InTouch module with	InTouch module with
	LCD and remote	LED display	LED display
AUDIO			
Wave-table	Hardware	Software	Software
support	wave table	wave table	wave table
VIDEO			
TV/FM radio capture card	Standard	Optional	Optional
 S3 Virge 3-D graphics acc 2 MB of high-speed 50-ns Supports up to 1280 by 10 	EDIO video memory		

CD-ROM

• Integrated 8x CD-ROM drive

AUDIO SUPPORT

Full-duplex 16-bit Sound Blaster Pro-compatible audio system with SRS 3-D sound

COMMUNICATIONS

- 28.8-Kbps fax/modem (software upgradable to 33.6 Kbps DSVD)
- Full-duplex speakerphone
- · Answering-machine application

EXTERNAL INTERFACES

- One serial (16550 UART-compatible) port
- One parallel (IEEE-P1284-compliant ESP-compatible) port
- One external SVGA monitor port
- One PS/2 mouse port
- Two universal serial bus (USB) ports

All bulleted items are shared by all models

- One PS/2 keyboard port
- One external microphone jack (monaural) One speaker out jack (stereo)
- · One line-in jack (stereo)
- · One MIDI/game port
- · AC IN plug

SINGLE UNIT PRICE

\$2799

\$1999

\$1699



Everything. Everywhere.

NOKIA 9000

It's everything you need to communicate: GSM phone, fax, short messages, Internet, e-mail, organizer. All working together. So you can receive e-mail, edit it, save it, fax it. Then call to discuss it, handsfree. And the Nokia 9000 Communicator is so small you can put it in your pocket and carry it everywhere.



FAULT RESISTANT RAID

IN 30 MINUTES OR LESS



• Hot-swappable drive trays, power supplies, & cooling fans

- Environmental monitors
- Internal battery backup
- Intelligent SCSI backplane (no internal cables required)
- Supports internal SCSI tape backup or other peripheral
- RAID levels 0, 1, 1+1, 4, @ 5 with single ended or differential host interfaces

Introducing CMD's new Daytona RAIDarray—

just add drives, and in minutes you'll be experiencing unmatched reliability and high performance. Daytona is the ultimate solution for applications requiring high performance, fault resistant desktop data storage on small to mid-size servers and workstations.

Daytona RAIDarrays are platform and operating system independent and come in four half-height and six low-profile drive configurations with support for up to 64 MB of SIMM-based data cache. In addition, each Daytona offers *plug@play* installation and low cost of ownership..

CMD has been a leading supplier of quality storage controller solutions since 1986. For more information on Daytona, or any of our outstanding RAID products, call us or visit our web site today at: www.cmd.com.



CMD Technology, Inc.

1 Vanderbilt, Irvine, California 92618 Ph. (800) 426-3832 or (714) 454-0800 • Fax (714) 455-1656 Circle 769 on Inquiry Card (RESELLERS: 770).

©1996 CMD Technology, Inc. All rights reserved. All trademarks belong to their respective owners.

LLUSTRATION: DOUG BUCHMAN © 1996

The Surging CTI Tide

Companies are replacing their PBXes with lost-cost CT servers.

By Bob Emmerson and David Greetham

ancing to the mantra of more for less money, companies are rapidly replacing once-sacred PBXes with multifunction computer-telephony (CT) servers, though most replacements start at the departmental level. Large corporations are also using dedicated workgroup CT servers but continuing to use a PBX for the tasks it traditionally does well: call switching and call accounting.

In today's computer-telephony-integration (CTI) architectures, the PBX operates just as a switch. The smarts are in the CT server that sits behind the PBX. Though more innovative PBXes now support APIs, they remain foreign bodies in an open computing and communications world. A CT server's plug-in boards process all kinds of call-related duties-interactive voice response (IVR), speaker verification, voice mail, fax on demand, and fax broadcast-and hand the call back to the PBX with a switching instruction. What's so difficult about switching a call? Why not provide PBX-like digital switching in a server?

Many vendors are now deploying CT boards with switching-matrix chips (e.g., Dialogic's SC 2000 or Mitel Telecom's MT8980). These boards plug into the server's system bus at the bottom and interconnect at the top using

a "mezzanine" telephony bus, a 40-pin ribbon cable. Calls come in on line-interface cards, get processed on the board, and switching instructions are added. The line-interface card then routes the call across the telephony bus to the next card.

For example, if a caller requests fax on demand, the line-interface card switches the call to a fax card; if a caller wants to talk to the sales department, the call will go to a telephony-interface card and be routed to a free agent. All this can be done without legacy switching, so you no longer need a dumb PBX.

The basic technology to do all this has been around for a while

from CT VARs and systems integrators. What's new is the rapid convergence of de facto hardware and software standards and the lower prices of industrial-grade PCs.

Windows NT is becoming the preferred OS for CTI applications, and most of the board vendors provide NT drivers. NT's Exchange Server can accommodate many users with mixedmedium message traffic and seamlessly route these messages to

Windows 95 Exchange clients. As Nick Wilson, managing director of Dialogic Telecom U.K., points out, "A giant leap will be the next version of Microsoft's TAPI [Telephony API], which allows users to control Windows NT-based telephony resources from TAPI-enabled clients."

Another development that is driving the move to computer-based switching is that board vendors are cramming more functionality into their products. Smaller organizations may soon be able to satisfy all their call processing and switching needs with a single board.

The Daytona voice cards from Pika Technologies (Kanata, Ontario, Canada), for example, have DSP-based (digital signal processor) voice-processing resources for up to 24 trunks per PC slot. These Multi-Vendor Integration Protocol (MVIP) boards (see the text box

"New Switch-Ready CT Boards" on page 48IS 12) come with a suite of DSP audio-processing capabilities, including full voice-card functionality, caller ID detection, and basic conferencing features. For high-end applications, you can use a daughterboard, which adds another 120 MIPS of processing power. You need this for computationally intensive tasks such as multichannel speech recognition or text to speech.

So, for less than \$7000, you can turn a PC into a PBX and get a fully integrated CT solution having all the functionality any small- or medium-size enterprise could need in the near term.

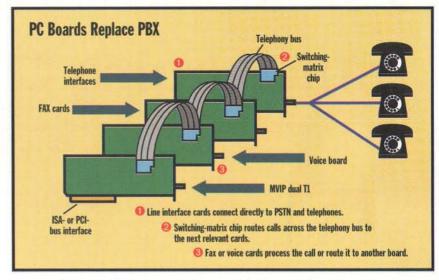


continued

"We see the future of traditional PBX technology as very bleak. Open PC-based multimedia technology is causing a lot of panic in the telecom dealer channel," says Paul Smith, CTI divisional manager at Northamber, a CT component distributor in the U.K. He adds, "The market potential of CT, especially for small and medium companies, is [in contrast] huge."

Scalable Solutions

There is an obvious physical limitation to the number of cards that can go into a PC. In turn, this limits the number of ports. The current record is 256 duplex ports for an MVIP system and 512 duplex ports for a Signal Computing System Architecture (SCSA) system. To extend this figure, you can use ISA extension boxes and build larger systems by interconnecting two or more PCs using multichassis MVIP buses. This feature gives PBXes in PCs their impressive scalability. However, there is also a limit to the number of PCs that you can interconnect: PC-based switching currently works at 1536 ports, whereas large PBXes can go to 10,000 ports and more.



Because CT boards deploy switching-matrix chips, they have the power to eliminate a corporate PBX.

"Although new standards are emerging that will increase this figure, the really big boost will come from ATM [asynchronous transfer mode]," says Ruud Peeters, marketing director of VSN Systemen, a CT software house. "Companies who can live within the limitation of 1500 ports and currently have a PBX might as well introduce CT on a departmental basis and then scale the solution up over time,

EUTRON. COMPUTER SECURITY

SmartLock

TOTAL PROTECTION FOR PC AND LAN



SMARTLOCK is the integrated protection system which assures total PC and LAN security: unauthorized access to computers, input of illicit software into company PCs, viruses, illicit use of personal computers. Remote and integrated management for LAN applications.

PC access control

Prevents unauthorized access to PC.
Provides an audit trail recording
application programs executed, users
and login times. Prevents unauthorized
booting. Limits the use of floppy disk
drives and peripherals. Executes
on-the-fly transparent cryptography of
the hard disk.

Company software control

Prevents unauthorized execution of illicit unlicensed software.

Takes census of company software.

Allows controlled distribution of new software licenses via digitally tagged floppy disks.

Antivirus

Provides the final solution to the software virus problem without requiring continuous updating. Takes preventive action by intercepting the viruses before they enter the PC, regardless of the type and techniques of attack.

Increases performance

Prevents the import of useless software (games, shareware, demos, etc.).
Avoids accidental deleting or modifying of files containing vital data. Prevents from modifying CONFIG. SYS and AUTOEXEC. BAT system files.

EUTRON 24048 Treviolo Bergamo Italy - Via Gandhi, 12 Tel. +39-35-201003 Fax +39-35-201277 - e-mail eutron@mbox.vol.it

- Belgium: Akkermans 03-2338826 Bulgaria: Vilmat 02-764533 Finland: Dalma 90-2711800 France: Logidata 1-46454546
- Greece: Inter Engineering 041-531363 Hungary: Montana-Kriptologia 1-2691191■ Poland: Gem Computers 022-261576
- Slovenia: Stubelj 065-63215 Sweden: JM Data 042-238444 Spain: Larcu 91-7952413 The Netherlands: Akkermans 046-4432424

Smart Routes to Connectivity

The number of PC connectivity paths in your organization has grown. Your users want to connect their PCs to the Internet, to hosts around the world, and to X clients. Mapping out these

routes requires the best PC-tohost connectivity software available - SmarTerm®.

SmarTerm crosses all the boundaries, taking Windows 95, Windows NT, and Windows 3.1 users to the information they need, no matter where it is. Whether valuable data is on their favorite web sites. X clients on their local UNIX host, a remote AS/400 host overseas, an IBM mainframe in the corporate office, a Digital host at a regional branch, or a Data General host anywhere, your users can extend the reach of their PCs.

The most complete multilingual connectivity suite offering a PC X

server, Netscape Navigator™ and multivendor host connectivity

including TN5250, TN3270.

SMARTERM

Essentia

A cost-effective multilingual

connectivity solution for enhanced telnet, FTP, and serial support for corporate users.

Windows 95/N

VT420, and DG D470

SmarTerm makes efficient, reliable and quick connections. It's designed specifically to reduce your training and support burden by including tools and utilities that automate common activities and integrate host and PC data. Plus SmarTerm is easy to learn and use, and the technical support is free!

Plot your connectivity course today! Call Persoft for a free evaluation copy of SmarTerm for Windows 3.1 or Windows 95/NT: 1-800-TCP-3130.

Persoft, Inc., 465 Science Dr., P.O. Box 44953, Madison, Wisconsin 53744-4953 U.S.A. Phone (608)273-6000, Fax (608)273-8227, 1-800-368-5283, or sales@persoft.com World Wide Web www.persoft.com, Faxback (608)273-6090

Persoft Inc, European Headquarters, Lower Woodend Barns, Fawley, Henley-on-Thames,



Superior multilingual PC

connectivity for the corporate user who needs multivendor

host connectivity including

TN5250, TN3270, VT420, and DG D470

SMARTERM®

Windows 95/NT

For Windows 95/NT

SmarTerm provides simultaneous access routes to the information you need-whether it's on the Internet, in X applications, or on UNIX, IBM, Digital, and Data General hosts.

Oxfordshire, RG9 6JF, United Kingdom, Phone +44 (0) 1491 638090, Fax +44 (0) 1491 638010

Copyright 1996 Persoft, Inc. All Rights Reserved. SmarTerm and Persoft are registered trademarks of Persoft, Inc. Netscape Navigator is a trademark of Netscape Communications. All other trademarks are property of their respective owners. Rev. 8/96. Circle 715 on Inquiry Card.

with the long-term objective being replacement of the legacy switching hardware when it has been fully amortized."

The move to PC-based switching is being hastened by easy-to-use CT applications generators that let programmers and even end users develop customized programs without having to be concerned with the nitty-gritty details of the connecting hardware. Sophisticated applications generators are quickly coming to market. Some recent European products are Envox CT Studio, from Envox, and NextInfo, from VoiceBit. They run in a Windows environment and have RAD-like (rapid application development) features.

A Universal API for CTI

What will ultimately pave the way to PCbased switching is a single standard for the boards and an API superset, a framework that can embrace other CT APIs-MAPI, TAPI, and Telephony Server API (TSAPI)and also handle PBX-type switching and call control. The Enterprise Computer Telephony Forum (ECTF), an industry consortium of key CT players, is work-

Your 24-hour Answering Service Sans P

PBXes normally have around three times as many internal extensions as incoming trunks. If you want more trunks than extensions, and if you want to use ISDN's multiple subscriber numbers and have up to 100 numbers per trunk, you have a problem.

Service Centrale Benelux (Oss, The Netherlands), a 24-hour guard and security service, had this requirement when it implemented a smart-call monitoring and answering system to reduce the number of false break-in alarms. "Each of our clients is allocated a dedicated phone number," says Ingo Heijst of Service Centrale Benelux.

"Currently, we have more than 100 incom-

ing phone numbers but only a handful of agents. In the future, there will be more, but they will not need additional agents." So the company deployed a PC-based switch solution on a Windows NT server with an ISDN 30B line-interface card and a station-interface board from VSN Systemen that connects directly to the phones. A Pentium Pro machine runs a call-monitoring application based on VSN's Open Telephony Service middleware that is not limited to the number of incoming calls. A 486 backup server running the same application updated by standard NT replication facilities guarantees 24hour operation without downtime.

ing on two standards: H.100 and S.300.

H.100 is a hardware standard that could finally merge MVIP and SCSA. It would let CT boards move up from today's ISA architecture to PCI. Dialogic (Brussels, Belgium), Mitel, and Natural

MicroSystems (Natick, MA) support it, so it may become a de facto standard. Expect to see the first H.100-compliant boards early next year. S.300, the ECTF's Service Provider Interface (SPI) specification, defines the management of call-channel

SuperMonitor for DOS, Windows

The flexible and versatile solution for your serial data and protocol analysis. The continous graphic user interface for DOS and Windows* guarantees an easy operation.

You are now able to considerably reduce your development time and costs when setting up or monitoring a serial link by using SuperMonitor.

SuperMonitor is able to execute not only simple short measurements but also long day and night runs. In Windows* up to two measurements can run simultaneously using the Twin version.

You even have the possibility as developer to extend SuperMonitor by using SuperCom the heart of SuperMonitor.



up to 115 KBit baud rate O up to 115 KBit bauf rate

⊃ parily: none, even, odd, mark, space

⊃ stop bits: 1, 1.5, 2 ○ data bits: 5, 6, 7, 8 ○ time stamps with a precision
of 10 µs ○ display of all modern lines ○ dynamic trigger function ○
extensive display, print and search functions ○ limited buffer only through the
PC memory ○ data swap-out for long day and night runs ○ display modes:
ASCII, Dec, Hez ○ up to two simultaneously running measurements in
Windows ○ IRQO..IRQ15 and any port address ○ includes special adapter,
cabel and 16bit serial board ○ PCMCIA-Version for Notebooks available I

SuperCom OCX for NT/Win95

The SuperCom OCX product integrates with VisualBasic and lets programmers very easily create COMM software. The SuperCom OCX is MSComm compatible. More than fourty Properties and Methods.

The SuperCom OCX supports dialing up using Hayes compatible modems and setting up file transfers using popular protocols like: ZMODEM (incl. crash recovery, 32bit CRC), YMODEM, XMODEM and ASCII. In addition the SuperCom OCX generates the events: OnComm, OnModem and OnFileInfo.

The OCX can also be used by any NT/95 compiler which interfaces with an OCX.

The OCX can also be used by any NT/95 compiler which interfaces with an OCX

Call us today for complete information or to "Windows=Windows 3.x + Windows 95 order. Ask about combo packs.

DEMO on CompuServe E E name). (User=ADONTEC, 0 RS232 +49-7043-9000-23 WINSDK, Key: RS2

RS232-Toolkit, SuperCom for DOS, Windows, OS/2, NT, WIN 95

for MS C/C++, Visual C++, VisualBasic, Turbo/Borland C/C++, Turbo/Borland Pascal, Delphi, IBM C/C++, WATCOM C/C++

SuperCom is the development tool for exacting serial communication software. That means high data security and highest transmission speed. The SuperCom libraries are fast even in a multitasking operating system like Windows 3.x, NT, Windows 95 or OS/2. The same programming interface is used among different languages and operating systems

- Interrupt driven: transmission, reception, linestatus, modem status. Ju to 115,200 bps.

 UARTS: 8250,16450, 16550 FIFO, any port address.
 Simultaneous COM_1...COM_36 (and unlimited).
 Direct register programming.* Interrupt-Sharing.
 Flow control: RTS/CTS, DTR/DSR, XON/XOFF and user defined. ANSI, TTY, VTS2.

 Protocols: 3964R, ASCII, XMODEM, YMODEM, ZMODEM (CRC16/32, crash recovery).
 Timer, CTH-Break and Exception handling.
 Multitasking support (Windows, NT, WINS5, OS/2)
 User Event Routines under DOS and Windows.

- User Event Routines under DOS and Windows
- Under Windows user can even post messages to the application using PostMessage.
- Interrupt driven: transmission, reception, linestatus, and a language independent DLL (Windows, NT, WIN95, modern status. Up to 115,200 bps.

 UARTS: 8250,16450, 16550 FIFO, any port address.

 Simultaneous COM_1..COM_36 (and unlimited).

 Multiserial board support (AST, ARNET, DigiBoard
 - by applications.
 Multiserial board support (AST, ARNET, DigiBoard PC/X, HOSTESS, STARGATE). Reduces loading of CPU through support of intelligent DigiBoard PC/Xe, PC/Xen, PC/Xib poards (up to 7 Boards/PC !!!).

 Modern support, RS422/485 support.
 Supports 286 DOS-Extender (e.g. PharLap, Borland) NO ROYALTIES. No resident drivers'. Just link the LIB.
 FREE technical support. FREE demo
 Full source code (C or Pascal and optimized ASM).
 SuperCom++ (C++ or Pascal OOP) included.
 Protected Mode Interface (Windows) included.

Call us today for complete information or to order. Ask about combo packs.

*Under DOS and Windows. Windows=Windows 3.x + Windows 95 16bit, NT=Windows NT + Windows 95 32bit

VISA, MC, COD.



COMM-Enhancer for Windows 3.x

Forget the Windows 3.x COMM API limitations. Use the COMM-Enhancer and extend your Windows 3.x COMM API based applications. Up to 40 channels (COM1...COM40!) and up to 115.200 bps. It uses SuperCom 3!!!

ADONTEC Computer Systems Ltd D-75433 Maulbronn, Germany Phone: +49-7043-9000-20 FAX: +49-7043-9000-21

Fine Line International 7000 Malone Rd, Forestville CA 95436, USA Phone: +1-707-887-3400 +1-707-887-1015 In Israel, call: Phone: +972-3-924-3555 FAX: +972-3-924-3132 Italy, call: Phone: +39-49-8713444 FAX: +39-49-8713055



APPLICATION DEVELOPMENT EMERGENCY!

Before you get dragged down by mounting development deadlines and budget overruns, call the "911" of application development tools: Magic. Magic delivers mission-critical client/server applications faster than any other tool on the market. It's been proven by consecutive victories at all of the world's top development competitions. And it's being used by companies like Rolls Royce, Matsushita, Gannett and Club Med. New Magic 7 adds Windows 95 and NT to Magic's wide range of supported platforms and databases. So download the Test Drive from the Magic Web site or give us a ring. Your client/server development projects could certainly use the lift.

Circle 712 on Inquiry Card (RESELLERS: 713).

Magic Software Enterprises
1642 Kaiser Ave.

Irvine, CA 92614

Tel: (800)345-6244, (714)250-1718

Fax: (714)250-7404



http://www.magic-sw.com

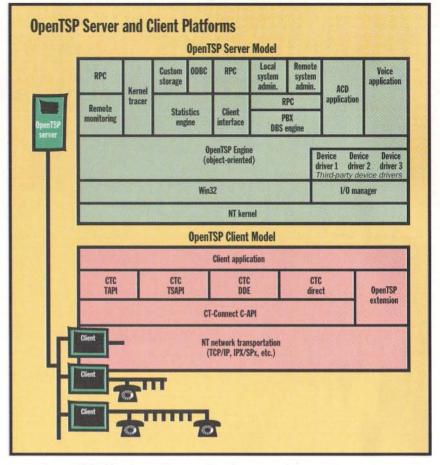
resources and interfaces for extending all kinds of system services. Industry players agree that it will take another year before \$5.300 is fully rendered.

CT Middleware

In the interim, systems integrators and software developers will continue to work with middleware and vendor-specific Software Development Kits (SDKs) to implement call-center applications or Automatic Call Distribution (ACD), Mitel is a driving force behind client/server telephony. Its MediaPath platform lets programmers develop CTI applications in C, C++, or Tcl/Tk (a public domain scripting language). VSN Systemen offers its OpenTSP Telephony Server Platform (see the figure "OpenTSP Server and Client Platforms"), which is object-oriented and enables you to process, reroute, or compress voice, fax, e-mail, and even video.

OpenTSP makes all the functionality of a top-flight PBX available to the client application. It also provides PBX statistics to the corporate database through an Open Database Connectivity (ODBC) link. This tightly integrated functionality lets developers implement powerful ACD systems on small systems at a relatively low cost.

This solution is particularly attractive for companies who have a legacy PBX but wish to add CT functionality (e.g., a call center). Instead of taking the TSAPI route, which entails paying for a CT link between the server and the switch, they can fit an OpenTSP server between the PBX and the public telephone network. Over time, the company can extend the benefits of CT applications to an increasing number of



OpenTSP Telephony Server Platform enables you to process, reroute, and compress voice, fax, e-mail, and even video.

users simply by adding more cards to the NT server and then by daisy chaining two or more of the servers together.

PBX-in-a-PC solutions switch voice calls to phones and also connect to the LAN for data communications (i.e., they use both cabling infrastructures). Eliminating the PBX brings the hardware cost way down and stops you being from being "locked in" to a closed, proprietary environment. However, it does not provide true integration of voice and data, because

New Switch-Ready CT Boards

Computer-telephony (CT) boards plug into extension slots of a standard PC or into the passive backplane of industrial-strength computers. They interface to the public network or the PBX, perform a variety of voice-processing functions, recognize DTMF digits, and then initiate an outgoing call or switch to additional resources (e.g., fax-on-demand service, voice recognition, or text-to-speech). To share resources within the PC chassis, these boards interconnect via a telephony bus—either Multi-Vendor Integration Protocol (MVIP) or Signal Computing System Architecture (SCSA).

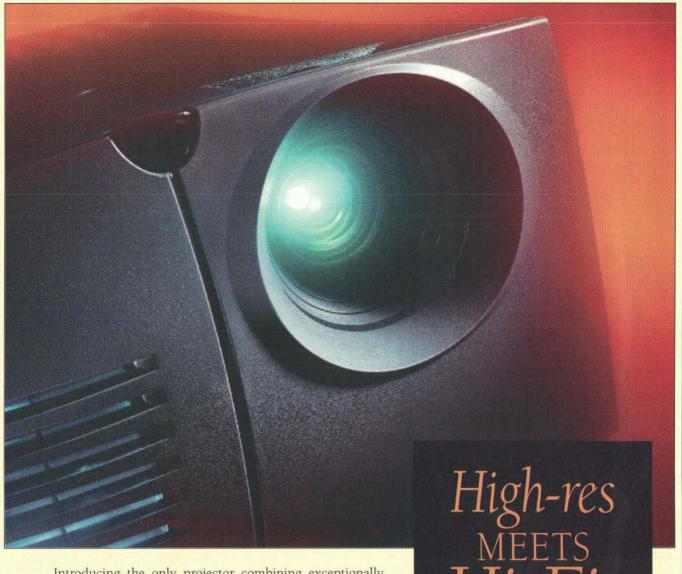
The digital-switching matrix that many CT

and line-interface boards now carry is a chip set that you can program for the switching and conferencing of digitized voice signals. Mitel's MT8980 chip, for example, switches pulse code modulation (PCM), digitized voice, and data under the control of a microprocessor.

The major vendor of SCSA-compatible CT boards is Dialogic (Brussels, Belgium). You can get MVIP boards from companies such as Rhetorex (Bracknell, U.K.), Pika Technologies (Kanata, Ontario, Canada), and Bitfield (Espoo, Finland), but there is no dominant board vendor in this camp. Market studies say that the SCSA front sells more boards, but you

have more choices in the MVIP camp. Over 150 MVIP-compatible products are available from more than 50 companies worldwide. Functionality and pricing are similar, but you cannot mix and match boards in the same PC housing. However, an SCSA-compliant PC will operate with an MVIP-compliant box (via multichassis MVIP).

Most CT boards are for the ISA bus, but many vendors are making the move to H.100 and PCI, thereby capitalizing on PCI's busmastering and DMA capabilities. Expect to see these new PCI boards at the beginning of next year.

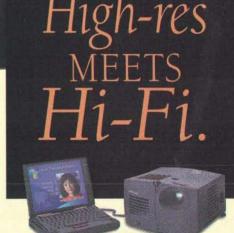


Introducing the only projector combining exceptionally smooth SVGA graphics and amazing shake-the-table sound – the new LitePro® 620.

For starters, it's got Digital Light Processing,™ so you get unsurpassed, film-quality graphics and video. And it's got a better audio system than most cars, featuring four high-powered JBL® speakers.

Plus, it projects a super-bright 400 lumens in full colour (an eye-popping 1400 lumens in Greyscale Mode). And since In Focus projectors are easier to connect and use, more people have bought them than any other.

So check out the new In Focus LitePro 620 today. It's where high-res meets hi-fi.





Great ideas. Brought to light.™



Discover electronic presentations. For a test drive or free demo disk call UK: 0500-262 440 Germany: 0130 813 649 France: 0590 5993 Italy: 1678 77238 Spain: 900 993 163

applications cannot treat voice as just another digital-medium type.

Many experts believe ATM is the solution because it integrates voice and data in one infrastructure. However, the price is high because the organization must install a new network environment. PhoNet Communications developed an interesting alternative. Its EtherPhone system uses existing Ethernet LAN structures and regular telephones. Combined telephone/network interface cards convert voice to Ethernet data packets and transmit calls over the data network in real

time. According to CEO Yoraon Baratz, EtherPhone eliminates the latency problem by monitoring the network load and changing the distribution behavior. The LAN server houses software modules for voice mail, ACD, and billing information. These modules also control the external interfaces and the telephony system.

You can achieve true CTI only when voice traffic runs seamlessly over a LAN infrastructure. EtherPhone is a great concept for companies with an Ethernet LAN in place and looking for an upgrade from a small key system to a PBX, but it can't

provide ATM's flexibility in transporting isochronous, multimedia traffic. Mitel and Madge Networks, for example, demonstrated a solution called Networked Voice and Data (NeVaDa) at Networks 96 in Birmingham, U.K. NeVaDa integrates real-time voice, video, and data onto a common, enterprise 155-Mbps ATM LAN backbone. It uses a single protocol to carry voice and data, thereby letting telephone and LAN traffic share one infrastructure and thus avoid the expense and overhead of two separate networks.

All these developments show that the closed, proprietary world of the PBX is over. The PBX will continue to have a role, particularly in large organizations, but the benefits of PC-based switching and advanced telephony are irresistible.

De facto open standards like SCSA and MVIP have created this market, enabling CT players to cooperate and compete. The work the ECTF is doing will carry this process further. Scalable solutions are already

What makes Velocis the fastest database?"

You do! Velocis™ Database Server gives you speed-enhancing architectural choices and APIs, including SQL C-API, low-level C-API, C++ class libraries, and support for custom APIs. Typical relational client/server database products just can't keep up. And there's more! Velocis supports both relational and pointer-based network model databases in any combination as well as processing on either side of the client/server equation.

The choices of multiple operating platforms, APIs, processing localities (client or server), and database models can be combined to satisfy the performance requirements of virtually any application, regardless of database size or complexity.

Call: 1-206-557-0200 Fax: 1-206-557-5200



Velocis	Typical RDBMS	Features
V	~	ANSI SQL (DML, DDL, DCL)
V	V	Client/Server Architecture
V	V	RPC Mechanism
V	~	SQL C-API
V		Administrative SQL C-API
V		Low-Level C-API
V		C++ Class Libraries
V		Custom API
V		Both SQL & C Stored Procedures
V		C-based Triggers
V		User Defined Functions
V		Server Extensions
V	V	Relational Model
~		Pointer-based Network Model
V		Combined Database Model
~	V	Primary/Foreign Keys
V	V	Referential Integrity
V	V	Transaction Processing
~	V	Transaction Protection
~	V	Roll Forward Recovery
V		Asynchronous Transactions

For more information on what makes Velocis the fastest database, call for a copy of the Bill-of-Materials Benchmark.

Test drive Velocis Database Server today at www.raima.com.

Raima Corporation, 1605 NW Sammamish Rd. #200, Issaquah, WA 98027 USA Inside the U.S.: 1-800-275-4724, Outside the U.S.: 206-557-0200, Fax: 206-557-5200, Web: www.raima.com, Internet: sales@raima.com

Germany: 49 7022 9256 10 Singapore: 65 334 0061 Italy: 39 49 720 577 Argentina: 54 1 470 72 03 Spain: 34 3 225 39 95 Raima UK Ltd.: 44 1 273 819 292 Australia: 61 2 419 7177 Denmark: 45 44 88 99 00 Raima Benelux: 31 35 694 4738 Colombia: 57 1 62 10 070 France: 33 1 446 100 42 Sweden: 46 13 311 588 Baltic States: 372 631 4009 Finland: 558 0 8045 130 Japan: 81 3 5548 6926 Russia: 7 812 316 1965

WHERE TO FIND

Envox Zagreb, Croatia +385 1 249070 fax: +385 1 249306 envox@alf.tel.hr http://ccb.tel.hr/envox

Madge Networks Europe High Wycombe, U.K. +44 1628 858000 fax: +44 1628 858011 dpool@madge.com http://www.madge.com

Mitel Telecom Slough, U.K. +44 1753 816300 fax: +44 1753 816333 dino_joannides@mitel.com http://www.mitel.com

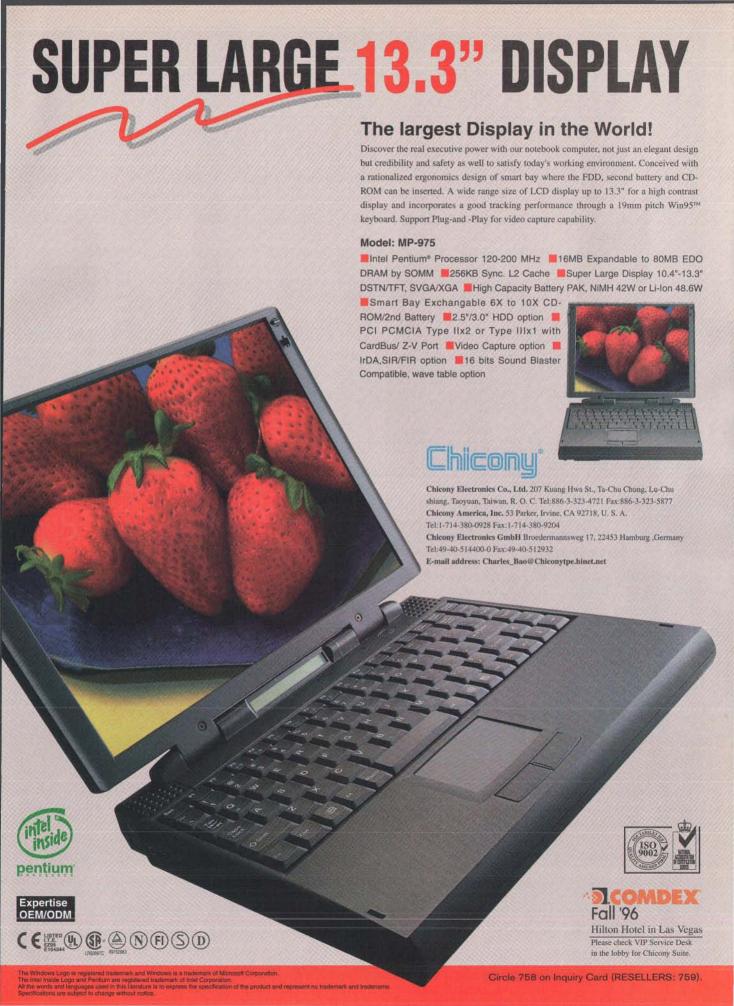
PhoNet Communications Herzliyya, Israel +972 9 502134 fax: +972 9 567432 phonet@shani.net

VoiceBit Oulu, Finland +358 81 537 2353 fax: +358 81 537 2338 juho.toivonen @voicebit.fi

VSN Systemen Venray, The Netherlands +31 478 555000 fax: +31 478 589563

on the market, but in the future, changing the feature set will be easier and the choice much wider. Dino Joannides, Mitel's director of business development in Europe, says, "Don't be surprised when shrink-wrapped applications that offer CT features of big PBXes start appearing on the shelves of your software dealer sometime next year."

Bob Emmerson is a BYTE correspondent who is based in Eindhoven, the Netherlands. David Greetham is a consultant with Greetham Associates (Turnhout, Belgium). You can reach them on the Internet at 73252.1364@compuserve.com or editors@bix.com.



secure

affordable



WINport/FAXport
a complete data communications
& fax server

LANSource Deutschland Tel: 5206 9124 24 info@lansource.de LANSource Technologies Inc. Toronto, Canada Tel: (416) 535-3555 sales@lansource.com www.lansource.com

LANSource UK Tel: 01954 782799 sales@lansource.co.uk

IPX ... Net Bios ... Net Bieu ... TCP/IP UDP ... IPX ... TCP/IP ... IPX ... Net Bios ... Net Bieu ... TCP/IP UDP ...

STRATION: DOUG BUCHMAN @ 1996

ATM Hits the Desktop

The corporate sector demands more powerful connectivity.

By Klemens Gaida

orporate interest in LAN-based asynchronous transfer mode (ATM) is on the rise. Market studies forecast that in the next three years more than 50 percent of ATM LAN implementations will be at the backbone level. Perhaps even more interesting, these studies also say that about 30 percent of these implementations will reach the desktop. Engineering, telemedicine, and LAN-based telephony and video applications are all fueling this great demand

for more powerful desktop connectivity.

From WANs to LANs

Although ATM started out as a carrier technology for WANs and the public network infrastructure, conventional wisdom said it would migrate down to LANs. But this hasn't happened as rapidly as expected, mostly due to the popularity of Fiber Distributed Data Interface (FDDI) and Fast Ethernet during the past couple of years.

Also hindering ATM's growth is the ATM Forum. This nonprofit organization, comprising more than 500 network vendors and telecommunications carriers, has issued so many specifications so quickly that companies are confused about which one to implement. They've found that drivers for ATM network adapters often don't support the heterogeneous structure of their

existing LANs. But this is changing, as interest in ATM connectivity to the desktop exceeds idle curiosity.

The concept of ATM was originally developed for digital Broadband ISDN (B-ISDN) WANs. ATM is a connection-oriented protocol that contains a connection identifier in every cell header. This connection identifier explicitly associates a cell with a given virtual channel (see "Virtually Well Connected," August BYTE). Traditional networks, including Ethernet, are not physically connected; systems communicate with each other

over a network bus rather than by way of direct connections.

These virtual channel connections (VCCs), which can be set up between any source and any destination on a network, are processed on ISO/OSI Layers 1 and 2 (the ATM layers). This means that network adapters must be able to process real-time communications and connection establishments. Also, adapter cards and switches need to understand the ATM signaling conventions and the quality-of-service (QoS) parameters of the ATM Adap-

tation Layer (AAL) (see the text box "Single-Chip ATM Adapters" on page 48IS 20).

Classical LANs share a common transmission medium and deploy a collisiondetection scheme, such as Ethernet, or a token protocol, such as Token Ring. In contrast, on an ATM LAN, no common transmission medium is used. With an ATM network, many simultaneous connections can be set up and maintained with different transmission requirements and without any collisions. This transmission method reserves the necessary bandwidth for each virtual connection.

The general construction of each ATM LAN switch corresponds to that of a public network switch. Typically, in an ATM LAN, terminators connect in a star structure to one or more centralized network nodes; the network sets up a connection via signaling. This technology gives

a network's users access to all ATM world services, from the public network to the desktop.

To support nonconnected data transmission in a WAN or public-network environment, carriers deploy dedicated servers, the so-called connectionless servers (CLSes), which process higher-level protocols. However, on a LAN, a dedicated CLS is not cost-effective, so new ways to let LAN users work with ATM must be found.

Current applications and OSes are not designed to work with

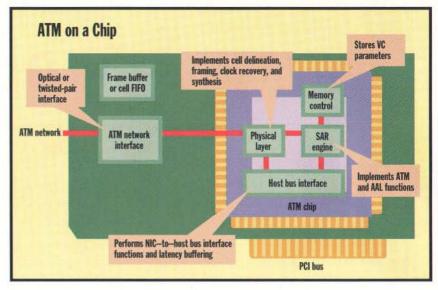


ATM networks. These applications have no way to talk to the underlying network to communicate the priority or the bandwidth that an ATM connection would require. In addition, the transport protocols of OSes such as Microsoft Windows NT and Novell NetWare are notorious for employing broadcast packets—a certain way to decrease the performance of ATM networks.

LAN emulation provides the interoperability layer between current, connectionless, LAN-aware protocols and applications and ATM networks, but it cannot take full advantage of ATM's potential to provide a higher QoS. For optimal ATM networks, OSes should minimize broadcast traffic and be smart enough to talk to the underlying network.

Major OS vendors are working on connection-oriented abstraction layers. Microsoft has licensed LAN-emulation code from Olicom (Lyngby, Denmark), and Novell is working with ATM hardware developers in the U.S.

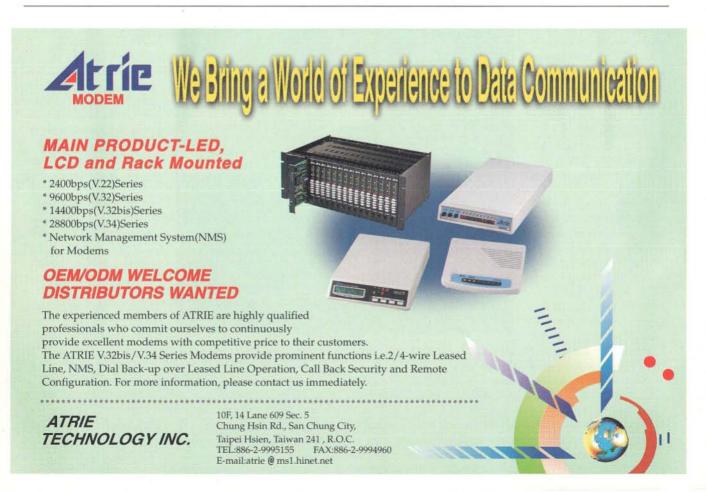
The ATM Forum has focused a great deal of effort on the definition of the User-



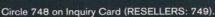
All-in-one ATM chips enhance performance and reduce the price of ATM network interface cards.

to-Network Interface (UNI) specification. In this particular context, *user* refers to an ATM client, and *network* refers to the ATM switch.

The main thrust of UNI is a standard signaling protocol based on the B-ISDN specification and the provision of a consistent address assignment in WANs and







Single-Chip ATM Adapters

ey to the flexibility of asynchronous transfer mode (ATM) is the ATM Adaptation Layer (AAL). It provides transport for many types of services within one format. The AAL inserts payload data into the 48-byte information field of an ATM cell and carries such network services as constant bit rate (CBR), variable bit rate (VBR), and available bit rate (ABR), which is most important for LAN emulation over ATM.

The AAL's duties aren't handled by the network, however; they must be overseen by the network interface card (NIC). The NIC's main tasks include real-time communications, interactive connection establishment, and LAN emulation (LANE).

There are two types of NICs for ATM: products that incorporate the logic in silicon on an ATM ASIC, and products that deploy a general-purpose processor and do the processing in software. Both approaches share a single goal: the one-chip ATM adapter.

For example, ATML's (Cambridge, U.K.) new Streamlink adapter board deploys an ATM chip, codeveloped by ATML and Cirrus Logic (Fremont, CA), that combines an ARM7 processor core, a PCI interface, and static RAM (SRAM) on a single die. The card's so-called AToM chip conducts the segmentation and reassembly (SAR) of all data that passes through the network, handles User-to-Network Interface (UNI) signaling, and performs LAN emulation.

The big advantage of having a NIC based on an embedded RISC processor is the resulting flexibility. To adapt systems to new environments, the software running on the processor can easily be updated. This is particularly important in the ATM world, where standards are not yet completely finalized. The Streamlink adapter is expected to be released in 25- and 155-Mbps versions in December, with prices starting below \$200 for the 25-Mbps version and below \$500 for the 155-Mbps version.

NICs that incorporate a single-chip ATM ASIC will hit the market early next year. In addition to having an ATM chip, they will deploy either a frame buffer or a plain first-in/first-out (FIFO) buffer. Because they will work without any external memory, these NICs will be priced

aggressively, industry sources say. However, FIFO-based chips rely heavily on fast bus-mastering PCI interfaces that use DMA to stream ATM cells into the host memory. Adapter cards with single-chip ATM ASICs will come from companies such as Olicom (Lyngby, Denmark).

ATM ASICs are being developed by such companies as Fujitsu Microelectronics (Manchester, U.K.) and Siemens (Munich, Germany). In addition, PCM-Sierra (Vancouver, British Columbia, Canada) released one of the first ATM ICs, the Lasar-155, earlier this year. This IC, which is designed for 155-Mbps ATM NICs, includes a FIFO buffer for eight cells in the transmit direction and 96 cells in the receive direction. ATM ASICs are said to perform more efficiently in AAL 5 functions (i.e., reassembly and error control) and in the scheduling of cells based on network burstiness (known as traffic shaping) because they don't have to cope with any software overhead.

Rainer Mauth is a senior editor and bureau chief in BYTE's Frankfurt office. You can contact him at rmauth@bix.com.

LANs. Another important development of the ATM Forum's UNI Signaling Working Group is the definition of QoS parameters in the connection-setup message for each VCC. These parameters include peak cell rate, peak burst length, and sustainable cell rate.

Today, ATM LANs establish connections as unspecified bit rate (UBR) services; this enables connections to completely depend on the switches' buffers. LAN connections should, however, be requested as an available bit rate (ABR) service, which is more appropriate for bursty LAN traffic. UNI aims at standardizing this service.

The latest UNI 3.1 specification, which was released last year, is not compatible with UNI 3.0. As a result, users have to ensure that their ATM adapters support both specifications. Expect the ATM Forum to release the next version, UNI 4.0, by the end of this year.

Currently, a refused connection in an ATM network leaves the client with just a single option: to try again later. UNI 4.0 will provide a negotiation/renegotiation scheme for QoS parameters and will give a client the option of changing the QoS during connection time. In summary, UNI 4.0 adds more flexibility to the signaling



** Parado

Software International

Avda. de la Democracia, 7 - Pl.3 n° 7

28031 MADRID - SPAIN



Tel: 34 1 301 30 15



FAX: 34 1 332 00 54



E-mail: info@pandasoft.es



Thanks to the FISKARS® PowerRite UPS, Bob finally discovered the cause of the recent crashes at www.dogtrainers.com.

re you too having strange problems keeping your web server online for your customers? The cause of all those mysterious disturbances may be simple – bad power. That's what causes 90 percent of all unexplained computer problems.

Luckily, the cure for bad power is simple too – a FISKARS® PowerRite UPS (Uninterruptible Power Supply), specially tailored for Internet servers.

Predictable power for the most unpredictable Web sites.

24 hours a day, the PowerRite smooths out any fluctuations in your server's power input. In extended power failures, the backup battery takes over while the LanSafe III software performs an automatic, controlled shutdown of your server, securing all data and closing down your connections in the correct order. When power resumes, your server is automatically rebooted.

So if your business is more and more dependent on reliable Web server operation, read more about FISKARS® PowerRite at www.fiskarsUPS.com/internetUPS/ – or buy now using our online order form.

Obviously, you shouldn't have any problems finding us online.

The complete FISKARS® PowerRite for Internet package includes

- a UPS unit (PowerRite Max, 700 VA)
 - the PowerWeb™ software for monitoring your UPS from any PC connected to the Internet
- the LanSafe III software
- · a surge protector
- · PLUS a free animated screen saver!





setup, but at the cost of greater protocol complexity.

Many of today's LANs and ATM LANs deploy multiple protocols. For such environments, ATM LAN emulation is a desirable solution because it provides a link between connectionless LAN protocols and the connection-oriented network. For pure TCP/IP networks, the classical IP-over-ATM specifications enable TCP/IP nodes to establish point-to-point connections.

An alternative to multiprotocol routing over ATM is the Multiprotocol over

ATM (MPOA) standard, which will be finalized by the ATM Forum early next year. However, it's important to note that MPOA is not a routing protocol in itself. It's more of an architecture that enables ATM clients to query routers or router servers about the best path through an ATM network.

In contrast to IP over ATM, LAN emulation deploys the TCP/IP protocol without modification. In addition, you can use classical LAN adapters, standard Network Driver Interface Specification (NDIS) and Open Data-Link Interface (ODI) drivers,

and all LAN protocols at and above Layer 2 over an ATM network. The LAN emulation (LANE) is processed by either the ATM adapter or, if legacy LANs are coupled through an ATM backbone, an ATM switch.

LANE implements a client/server architecture to map Media Access Control (MAC) addresses to ATM addresses (a process known as *address resolution*). In this terminology, the LANE client is the workstation, and the server is a service implemented in the ATM network. The drawback of this concept is that LANE supports only data transmission, not voice or video transmission.

LANE supports three different network structures (all-ATM, LAN-to-ATM, and LAN-to-LAN) using ATM as the backbone, thus providing a step-by-step migration path. When the coupling of LANs over ATM does not meet the requirements of corporate network traffic anymore, a company can link single workstations or segments to an ATM backbone or create an all-ATM LAN. In connecting the local

WHERE TO FIND

network to the public ATM infrastructure, users can create a homogeneous enter-

In the future, when more LANs quit the shared-medium era and move on to connection-oriented switching, there's a good chance that even the internal structure of a workstation might follow this trend. Then all peripherals may feature an ATM interface that connects to a PC's

The big advantage of an ATM I/O bus

will not be the resulting high data transfer rates; these may eventually be outperformed by other technologies, such as the Fibre Channel protocol (see "Fibre Channel: Fast and Flexible," May BYTE).

Rather, the user of an overloaded computer could expand system resources just

Olicom

Lyngby, Denmark +45 45 270000

fax: +45 45 270101

http://olicom.com



by setting up another VCC on a companion workstation without interrupting any other data transmission.

ATML

Cambridge, U.K.

prise network.

internal ATM coupling field.

+44 1223 566919

fax: +44 1223 566915 http://www.atml.co.uk

Klemens Gaida is a consultant with Eutelis Consult (Ratingen, Germany). You can contact him at editors@bix.com.

TAINET COMMUNICATION SYSTEM CORP.

1996 NOV. 19~22 Booth No: B510-514 B510B-514B

TAIPEI TELECOM

Headquarters: 3F. No.6, Alley 23, Lane 91,Sec.1, Nei-Hu Road, Taipei, Taiwan, R.O.C TEL: 886-2-6583000 FAX: 886-2-6583232 E-mail: #sales@accmail.tainet.com.tw URL: http://www.tainet.com.tw





EH2005-TX

Just Plug it in!

With Accton it's that simple!

Has your current Ethernet network got you pulling your hair out because it's too slow and troublesome to upgrade? Here's the answer! Accton's Fast Ethernet and Switches give you high performance-without the hassles.

Upgrading is easy. Designed for plug-and play installation, our products are fully compatible with existing Ethernet networks- protecting your current network investment. With Accton Fast Ethernet and Switches you can see immediate performance gains with no additional infrastructure expense.

For more information on Fast Ethernet and Switches call your local Accton distributor today.









Designed for optimal

communication,

productivity.

& pleasure.

Ideal For The Home & Office

COMDEX Fall '96 Visit Mitac at Hall S-2, L2435

The Intel Inside Logo and Pentium are registered trademarks of Intel Corporation. Specifications are subject to change without notice or obligation.

MITAC (

-Tel:886(3)3289000 Fax:886(3)3280928 ■ MITAC JAPAN CORP. Tel:81(3)5420-2822 Fax:81(3)5420-4586 MITAC AUSTRALASIA PTY. LTD. Tel:61(3)9540-0555 Fax:61(3)9540-0588 MITAC DE MEXICO, SA DE CV − Tel:52-5-2603399 Fax:52-5-2600616 MITAC PACIFIC (H.K.) LTD. Tel:(852) 2528-6782 Fax: (852)2861-3754 BRUNEI − OA System Compute Tel:673-2-244640 ■ EGYPT- EGOS Tel:202-4548800 ■ INDONESIA-PT. Inforindo Naditama Tel:62-21-3913633 Fax:62-21-3842662 ■ ISRAEL-Militon Tel:972-3-9255255 Fax:972-3-9255222 ■ KUWAIT-ZAIDAL-KAZEMI SONS Tel:965-2451680 ■ MALAYSIA-Alpha Data SDN BHD Tel:60-3-7546666 Fax:60-3-7545555 PHILIPPINES- Intergrated Computer Systems INC. Tel:632-722-4111 Fax:632-721-2113

■ SAUDIARABIA-NAHIL Tel:1-4645373 Fax:1-4645965 ■ SOUTHAFRICA-AZ Computer Tel:27-11-3141219 Fax:27-11-3141656
■ THAILAND-IFECTel:662-559-2419 Fax:662-559-2418■ TUNISIA-Standard Sharing Software Tel:216-1-796000■ TURKEY-AlbimTel:0-216-3493351 Fax:0-216-3477069 E-mail: market@smtplink.mic.com.tw (URL): http://mitac.mic.com.tw

Circle 742 on Inquiry Card (RESELLERS: 743).

MITAC navigator, Discovery 3-language OCR fax-scanner Software bundle worth over US\$1,500 Front-centered IrDA transceiver/receiver Windows® 95/MS keyboard & mouse 166-200MHz Intel® Pentium® processor 128 RAM/1.6GB HDD Internet ready/28.8 voice modem Speaker-phone/8x CD-ROM drive

3D graphics & sound/MPEG card And much more ... Yours to ENJOY

Get MITAC's Pursuit and delve into endless enjoyment.

Meet Discovery, MITAC's navigator. Providing instant ease-of-use, this fun and eve-catching Windows® 95 -enhancer makes computing a lot easier and more fun for everyone.

Scan and edit text and graphics in a flash. Move data from your notebook, PDA or digital camera to your Pursuit at warp speed, easily. Or use Pursuit as your phone, fax, Internet/e-mail machine, and even as your stereo & video player.

Enhance your skills with super communication software. Entertain yourself with exciting games. Or pursue many other computing thrills at a speedy 166MHz Intel® Pentium® processor and awesome 3D graphics & sound.

Get a MITAC Pursuit today and enjoy.

ILLUSTRATION: DOUG BUCHMAN © 1998

The Rise of Asian PCs

Expect more powerful PCs and servers for less money.

By Mark LaPedus

sian PC companies experienced mixed success in the early 1990s. However, they are now making a resurgence in the worldwide desktop and server markets, as they begin to leverage their strengths in consumer electronics. Taiwan's Acer, which had major losses in the early 1990s, is projected to jump from being the world's eighthlargest PC supplier in 1995 to the second-largest player by the year 2000, says Jason Lin, an industry analyst at Dataquest Tai-

wan. This will put Acer next to Hewlett-Packard.

Japan is also knocking on the door. Last spring, NEC merged its international PC operations with Packard Bell, forming the world's largest PC company. What's more, NEC, Fujitsu, Hitachi, Toshiba, and Sony will expand or reenter the worldwide PC and server markets later this year. The timing couldn't be worse for these companies. Amid falling margins and a price war in the industry, all PC makers are finding it increasingly difficult to differentiate their products.

Unlike consumer electronics, Asian companies do not drive the PC business. Thus, to get a feel for where the PC is heading, it's important to look at what Intel and Microsoft, the dominant forces in the industry, are planning. By the end of the year, Microsoft will unveil its PC 97 Design Guide, a set of

guidelines for designers of future PCs and peripherals—which, of course, must be compliant with Windows 95 and NT.

For Intel, "the driving force for the Pentium Pro will be the acceptance of Microsoft's Windows NT 4.0," a 32-bit OS with the Windows 95 interface that takes full advantage of the superpipelined architecture of the microprocessor unit (MPU), says Takahiko Umeyama, senior PC analyst at IDC Japan. In fact, Acer, Compaq, NP, IBM, and others are rushing to release their Pentium Pro-based NT servers.

As a result, Pentium Pro–based system prices are dropping. In the middle of this year, for example, NEC's PC-9821Ra20, which sold for \$3980 in Japan, came with a 200-MHz Pentium Pro processor, 16 MB of RAM, a 1.2-GB hard drive, 64-bit PCI graphics, and a 100-Mbps LAN controller. And Dell's Optiplex GXPro 200 Pentium Pro–based machines cost \$2899 for the entrylevel 180-MHz system, about \$5000 for a midrange 200-MHz desktop, and \$7990 for a dual-CPU system.

By the end of this year, however, you will get much more for your money, according to people familiar with Intel's systems road map for OEM customers. For example, an entry-level Pentium Pro-based desktop with roughly the same features as NEC's PC-9821Ra20 could go for only \$1800 or less—nearly the same price as a 133-MHz Pentium-based PC in the middle of this year. A midrange desktop based on a 200-MHz Pentium Pro may cost \$2000 to \$3000.

A full-blown box will include 32 MB of RAM, a 1.2-GB hard drive, 64- or 128-bit (or 3-D) graphics, an eight-speed (or faster) CD-ROM drive, a 10-/100-Mbps LAN card, full-duplex audio, videoconferencing capabilities with a charge-coupled-device (CCD) camera, a 15-inch monitor, and the universal serial bus (USB), which connects up to 127 peripherals over a 12-Mbps

network. (Intel is still wavering about support for a competitive technology endorsed by Apple and Sony, called IEEE-1394 or Firewire, a bus that offers 100- to 400-Mbps transfer rates.)

A high-end 200-MHz Pentium Pro desktop could go for \$3200 or less. It has features similar to midrange desktops, but the highend box supports NT 4.0 and other OSes, as well as 3-D graphics controllers that provide z-buffering, color interpolation, texture mapping, rendering, and arcade-game-like functions. There is support for 3-D APIs such as OpenGL, Direct3D, and others.



continued

www.cgk.com

47,000 PRODUCTS — ONLINE ORDERING

Multimedia

SoundBlaster 32 Plug N Play	DEM 115
Macromedia Director 5.0	808
Proxima Ovation 820 Active	2252
Radius VideoVision Telecast	5010
Turtle Beach Tropez +	207
TrueVision Targa 2000	3854

Backup

Colorado Taravan 1000 Internal....139 Exabyte 8205 76B I/E...1259/1500 Exabyte 8505 14GB I/E 1861/2103

We have what you want Surstre 2/4/8-1668.562/660/R43
Surstre 2/4/8-68734 Semail or of the surstre 2/4/8-68734 Semail or of the surstress of the sur

12x12 Cordless Calcomp 12x18 Cordless 357 Calcomn CM Thermal E Size 6477 Calcomp DM 600 E-Size 9666 Numonic Grid Moster 50X60 SummaSketch III 12x12 SummaSketch MGrid III 44x60 .. 2881

Computers

BTG Alpha 275 16M/500M	6692
DEC Pentium and Alpha	CALL
HP - All models	CALL
Intel MB Endeavor w/sound	CALL
Intel Atlantis 166 sound+VGA	CALL
Intel Aurora Board	CALL
w/Pentium Pro 200	CALL
StarLite 256K PL w/CPU P100	270
StorLite 256K PL w/CPU P200	300

Hard Drives

-0	ALL for tod	ayis pri	ce!-
WD IDE 8	50/1.26/1	.66/2.	16/2.56
	.160/206/	/225/2	98/346
Quantum	1.286B IDE		204
Quantum.	Atlas 4GB S	CSI	853
Seagate 1	.26B IDE		170
Seagate 2	.1GB IDE		275
Seagate 4	.26GB SCSI		1150
Seagate S	T410800N	968	1900
Seagate S	T410800W	9GB	1950
	129(2)	5.5	0.00

Graphics Cards A DON DEL DEL

ATT WINDOOST DICAM FLT UCM
1MB/2MB100/119
ATI PRO Turbo PCI/VLB255
DIAMOND ALL OEM MODELS!! CALL
Diamond Stealth 3200 2MB VRAM250
Diamond 3240XL 2MB PCI261
Diamond 3400 4MB PCI386
Matrox Millennium 3D 2MB239
Matrox Millennium 3D 4MB348
Number 9 Imagine 128 2MB358
Number 9 GXE 64 Pro 64 4M307
Number 9FX Motion 771 4MB427
Orchid Kelvin 2 MB 64-bit PCI 117

Controllers

Adaptec 2940 Single	173
Adaptec 2940UW PCI Kit	263
Adaptec 3940 PCI Kit /UW .3	68/426
Buslogic BT946C SCSI PCI	179
956C/9582	17/226
DPT Smartcache IV	CALL
MYLEX Raid all models	CALL

Modems/FAX

monomis/ 1948
BOCA 28.8 V.34 I/E109/163
ETECH 28.8 V.34 Int/Ext100/125
Hayes Optima 28.8 V.34370/430
Multitech All ModelsCALL
Puredata SatisFaxtion 500 Int420
Shiva Net Modem807
Supra 33.6 1/E131/142
USR Courier V.Everything
USR Sports 33.6 1/C
USR Couring Co.
IICO TO THE TOTAL OF THE TOTAL

CPU (Intel, Cyrix, AMD, DX4, PENT) CALL

All Upgrades - AST, Apple, Compac, DEC. HP. IBM. Silicon Graphics, SUN. SIMM & PROPRIETARY

MEMORY - Call For

Today's Price

pentium"

and Pentium Pro: TOO LOW to print!

Network

the same of the sa
Novell Networe 3.12/4.1/SFTCALL
3COM Etherlink III Combo Bulk79
3COM Fost 100Mbs TP PCI 32Bit .158
3COM LinkB 12Port 100Mbs Hub1930
Campaq IPG - All modelsCALL
Cisco Bridge & RouterCALL
Intel EtherExpress Pro PCI 100208
NE 2000 Compatible35
NE 2000 Plus75
NE 5500110
SMC EtherEZ-CO/TP/Cbo88/88/98
SMC EtherEZ PCI Combo159
SMC EtherPower PCI 10/100Mbit 153
5 PACK/20-PACK/50-PACK/100-PACK

OS/Etc.

Windows NT 4.0 Server +5	741
OS/2 3.0 Warp CD-ROM	
Sun JAVA Workshop NT	
Sun Netscape Commerce	
Solaris DT	480
Solarnet	230
Windows 95 on CD	90
Sun Firewall Lite	3400
ALL OS available - please call	for price

CD-ROM/Optical

Teac CD-56E100	
Toshiba SCSI 54028125	
Creative IDE 8X110	
rujitsu Mag/Opt 230MB 3.5 Ext .432	
innode RCD5040 I/E812/902	
Smart&Friendly Recorder 597/697	

47,000 Item Catalog **Program with Current Prices** Free with Order

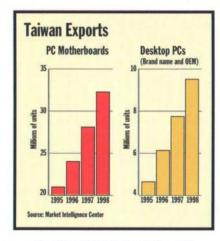
PHONE: (415) 861-8330 Español/Français: (415) 861-8376 Deoler Discounts | FAX: (415) 861-8380 | email: salas

Low bright rates—US and International * No handing charge * Prices are for cod pre-payment * VISA/MC/ MMCN congente * Products may be USA westions * Deficitive enhancs for replacement only * Prices are FOB USA and subject to change * 15% restocking charge on all nondefective returns * No return on open softwar * All nondemarks are the properly of their respective warmers.

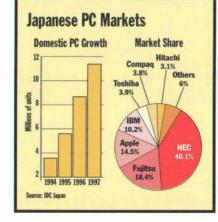
Computer Quick, 165 - 8th Street, #309 San Francisco, CA 94103, USA

(In 1997, Intel will implement its Accelerated Graphics Port [AGP], a memory bus that provides a 200-Mbps link between the graphics accelerator and the chip set, bypassing the overtaxed 133-Mbps PCI bus.)

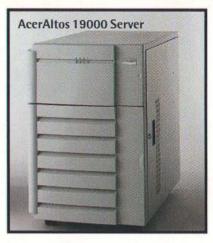
Intel's road map implies that a key for all desktops is connection to the Internet. "The 14.4-Kpbs modems are being phased out," says T. G. Wang, vice president of Taiwan's GVC, the world's second-largest modem maker as well as a major supplier of PC boards, notebooks, and monitors. "Faster modems or ISDN will become necessary for many applications." GVC will enter several new modem markets by the end of the year: Digital Simultaneous Voice and Data (DSVD), Asymmetric Digital Subscriber Line (ASDL), cable modems, and others. The most promising one is DSVD, which simultaneously transmits data and voice signals over a single dial-up phone line using V.34 modulation.



Exports of Taiwan's desktop PCs and PC motherboards.



Growth of Japan's domestic PC market and market share of PC companies.



1997 and Beyond

Early next year, PC makers will begin to offer systems based on the next-generation Pentium chip, the long-awaited P55C, a 200-MHz device with multimedia extensions, dubbed MMX, MMX will boost performance on many audio and video applications. Intel will also have a new-andimproved Pentium-level chip set. Called the 430TX, it supports extended-data-out (EDO) and synchronous DRAM (SDRAM), USB, AGP, and other functions.

In early to mid-1997, look for desktops and servers based on Intel's next-generation Pentium Pro, code-named Klamath. It's a 200-/234-MHz MPU with a larger L1 cache than the current MPU but no internal L2 cache. Next year, Intel will also talk about the code-named Deschutes, a lowpower version of Klamath, reportedly for use in notebooks. Both Klamath and Deschutes will include MMX. By then, Intel will also have a new chip set for its Pentium Pro, called 440LX, which supports multiprocessing, SDRAM, USB, AGP, and other features.

In the next year or two, PC makers may offer fast accelerators based on Microsoft's Talisman project, an effort that hopes to put high-end workstation graphics on inexpensive PCs. In theory, Talisman displays 3-D objects by using a highly intelligent chip called a compositor, which picks up and textures polygons on the fly.

"Next year, we will offer a home PC based on a Pentium Pro," says Arthur Pai, director of product management at Acer, which is also reportedly looking at the P55C for the home market. "We will also offer [Klamath] for our entry-level and midrange servers."

You shouldn't expect the P7-a 64-bit

Flatbed Scanner Series: Desktop Publishing Scanner

Avision's Desktop Publishing scanners generate sharper colors at Faster speed. These color scanners have a range of 300 dpi to 600 dpi and support 24 bit, 30 bit to 36 bit color. With Avision's color matching technology you have "What-You-See-Is-What-You-Get" with your color photos. All Avision color scanners are compatible with PC or



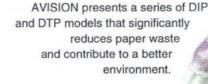
Document Scanner Series: High Speed Scanner (AV 800)

Avision document scanners are engineered for both document image processing and desktop publishing. The built-in automatic document feeder holds up to 50 pages and can reach the speed of 10ppm, 20ppm and 30ppm. These high speed scanners have 300 dpi resolution and support B&W, 256 level gray and 24 bit true color. Along with the industry standard TWAIN & ISIS drivers these scanners come equipped with an

interface card.



"WHAT YOU SEE ON PAPER, YOU CAN SEE IN YOUR COMPUTER" and with a decade of experience in designing image scanners.





IT'S VERY WELL MADE IN TAIWAN

Portable Sheetfed Scanner Series:Personal Scanner

The AV100 series personal sheetfed scanners can scan at 300 dpi. They are equipped with a 10 page Automatic sheet feeder and scan at a fast 7 ppm. These portable scanners support B&W, 256 levels gray scale and 24 bit color.

With its small 11.6"x4.2" footprint, these scanners make a perfect SOHO partner that perform multiple functions such as Fax, Email, OCR, Image Editing and

Electronic Filing.

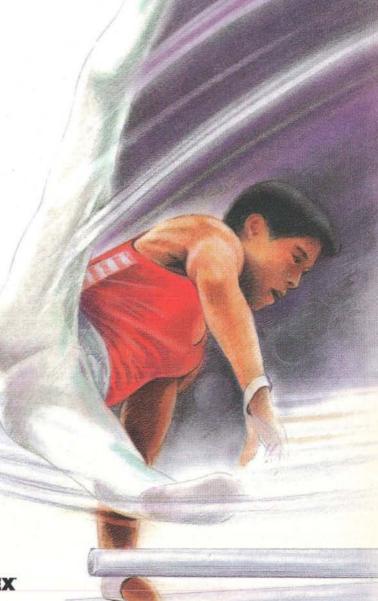


AVISION INC.
No.20, Creation Rd. 1, Science-Based Industry Park HsinChu, Taiwan, R.O.C.
TEL:(3)5782388, FAX:(3)5777017

- ★ South Europe: Mitas Italia, TEL:39-471-540940, FAX:39-471-540949
- ★ East Europe:HUMANsoft Electronics Ltd. TEL:361-163-2879, FAX:361-251-3673
- ★ Germany:bhs Binkert TEL:49-7753-92080, FAX:49-7753-1037 ★ Austria: Typhoon Asia Impex
- *Austria: Typnoon Asia Impex
 TEL:43-1-7075566, FAX:43-1-7075553
 *U.S.A.:Avision Lab. Inc.
- TEL:1-510-440-8785, FAX:1-510-440-8337
 ★ Brazil:SND Electronica, Ltda.
 TEL:55-11-2233000, FAX:55-11-2230533

See Us at

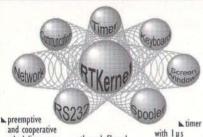
COMDEX
Fall '96
Sands Expo,
Booth \$4587



Professional Real-Time Tools

RTKernel Real-Time Multitasking for DOS and 16-Bit Embedded Systems

- ► Real-Time Multitasking for:
 Borland C/C++, Microsoft C/C++, or Borland Pascal
- ▶RTKernel supports: MS-DOS 3.0 or higher, Embedded Systems without DOS, Paradigm Tools (info available), Turbo Debugger, CodeView



- and cooperative scheduling ⊾up to 64 priorities
- ▶ your program's functions run as parallel tasks
- ► Windows can run in parallel with RTKernel tasks
- ▶ inter-task communication
- through Shared Code/Data, ► real-time semaphores, mailboxes, messagepassing
- unlimited number of tasks, about 1K per task needed
- h timer rate adjustable from 0,1 to 55ms
- ► Developer's License: \$550 complete Source Code: add \$500 no run-time royalties

Cross Development System for 32-Bit Embedded Systems

▲ interrupt

library

0 or 3

PF-files

privilege level

▶ serial

latency <5 µs

communications

▶ locator for Win32

resolution

capabilities

through event-

driven scheduling

drivers for screen,

keyboard, up to

38 COM ports, IPX

services, floppy disks, hard disks,

- ≥32-Bit Development System for: Borland C/C++, Microsoft C/C++, Watcom C/C++
- RTTarget-32 supports: Intel 386/486 EX/SX/DX(2), as little as 16K RAM/ROM



- boot code for floppy, hard disk, EPROM disk
- program download **▲** optional paging ► supports standard PCs and controller and RAM
- remapping ► FLAT memory model with
 - physical = logical
 - ▶ fully supports the systems (printf,

boards

- C/C++ run-time malloc, etc.)

at 115200 baud

▶ Developer's License: \$1700 complete Source Code: add \$1000 no run-time royalties



sional Programming Tools

Free demo disk!

(03) 9580-1333

Karolinenstrasse 32 20357 Hamburg GERMANY Phone +49-40-437472 Fax +49-40-435196

CompuServe 100140,633

On Time Marketing

44889900 1-30660136 (049) 871-3444 (04) 642-2595 On Time Marketing (516) 689-665

Asian PC Companies Form Complex Partnerships

o relaunch their PC businesses, Asian vendors, especially those in Japan, are taking different paths than in years past. Instead of trying to make every PC component, they are forming complex partnerships and manufacturing alliances with outside companies (and sometimes competitors).

Most Asian PC makers are taking one of three routes to get their desktops to the market: Go with Intel or Taiwan-or both. For example, Sony and Toshiba will have their new PCs made on an OEM basis by Intel. Sony and Toshiba will also buy PC boards and processors from Intel.

In contrast, Fujitsu and Hitachi are buying PC boards and systems from one source: Acer. Meanwhile, NEC, Japan's largest PC maker, last spring merged its international PC operations with Packard Bell. The companies will join forces in product development, except in Japan. They also have an OEM deal and monitor joint venture in China with Taiwan's GVC

"Japanese PC companies are concerned about getting their manufacturing costs down," says Colley Hwang, director of the government-sponsored Market Intelligence Center in Taipei, "So I think you'll see more partnerships between Japanese and Taiwan companies."

To get a hint of what's coming from some of these vendors in the desktop arena, it may be useful to find out what Taiwan is doing with motherboards. Acer will ship the AP65, a baby-AT PC board that supports Pentium Pro processors ranging from 150 to 200 MHz. The AP65 comes with Intel's 440FX chip set, up to 512 MB of extended-data-out (EDO) DRAM, four 32-bit PCI slots, and three ISA slots. Acer also offers boards based on the emerging ATX form factor. ATX is a baby-AT baseboard rotated 90 degrees.

Later this year, Asustek will ship a board

for Pentium-based PCs. The PI-XP65UP607 comes with a riser or daughtercard that provides a smooth upgrade path from the Pentium to the Pentium Pro. This ATX-based design comes with the 440FX chip set and a SIMM socket that supports EDO DRAM. Asustek will also offer a board with a Pentium Pro-level chip set from SIS.

This fall, First International Computer will ship the PA-6010, an ATX board built around Via's Pentium Pro-based core-logic IC, the VT82C680 Apollo chip set, a three-piece solution. The board supports EDO DRAM, burst-EDO (BEDO) DRAM, and synchronous DRAM (SDRAM). It also supports four 72-pin SIMM or two 168-pin dual-in-linememory-module (DIMM) configurations. Like the boards from Acer and Asustek, the PA-6010 also supports the universal serial bus (USB). First International's board will sell for \$150.

By the end of the year, GVC will offer a range of Pentium Pro-based boards. Its first two boards, the ASP620 and ASP621, are ATX designs that support the 440FX chip set. 3-D graphics, 16-bit sound, infrared, and USB. The next board, the ASP610, is a lowcost solution that supports these features as well as Intel's Accelerated Graphics Port (AGP), a high-speed memory bus that provides a 200-Mbps link between the graphics accelerator and the chip set.

Next year, GVC hopes to show a board that will support Intel's next-generation Pentium Pro chip, code-named Klamath. This ATX board will support AGP, 3-D graphics, USB, and other features. GVC may also have an all-in-one board based on Chromatic Research's Mpact chip, a multimedia processor that has 3-D graphics, 16-bit sound, video, a fax/modem, and other functions-all on the same IC-says Kenny Huang, marketing manager.

787-based processor currently being codeveloped by Intel and HP-until 1998. The P7, code-named Merced, is for high-end Unix servers. Contrary to popular belief, though, Merced won't use a very-longinstruction-word (VLIW) design; instead, it will use a modified superscalar architecture with instruction-level parallelism, sources say.

New Japanese Push

Japan's PC industry is gearing up for a renewed push into the U.S. With the exception of Toshiba, which is the world's largest notebook maker, most Japanese computer suppliers have mainly focused on the domestic market.

As mentioned earlier, NEC, Japan's largest PC maker with more than 40 percent of the market share, has merged its international PC operations with Packard Bell. Meanwhile, Toshiba will sell in the U.S. a new line of PCs that are geared for the home market. Earlier this year, Fujitsu entered the notebook field. This fall, it will launch a line of desktops and servers

STORAGE AUTOMATION



Exabyte libraries employ sophisticated technology like intelligent robotics and multiple drives working parallel to ensure fully automated back-up and rapid file retrieval. When equipped with our new Mammoth drive a single library can store from 140 gigabytes up to 3.2 terabytes of data at a transfer rate up to 86.4 GB/hr.

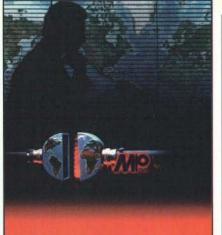
As the leader in 8mm technology we have designed our libraries to be compatible with multiple software applications across all client/server platforms. Exabyte is the only manufacturer to design all the components in a family of libraries; these include drives, media and robotics. Our tape library expertise eases integration, assures a clear upgrade path and delivers superior performance, capacity, reliability and fully automated back-up.

For more information about Exabyte's tape library family contact Exabyte's phone service: +31 30 25 48 890 BBS +31 30 25 81 657, http://www.exabyte.com

Superior automated
back-up and restore
from the world's
largest manufacturer
of 8 mm tape
libraries.

Circle 765 on Inquiry Card (RESELLERS: 766).

Exabyte Europe, tel: +31 30 25 48 800, fax: +31 30 25 81 582, Pythagoraslaan 100, 3584 BB Utrecht, The Netherlands EXABYTE*
THE STANDARD IN STORAGE



Have you lost your memory lately? When was the last time you were lost in the dark?

Best Protection From Main Power

Established in 1989, we have rapidly become one of Taiwan's premier developers of uninterruptible power systems. We are constantly developing new and innovative products designed to meet your requiremen today and into the future.

The Total Solution

In addition to UPS products, we also offer a full line of UPS monitoring and shutdown software products available for most operating systems.

The UPS of the FutureToday



Line Interactive LIPS 600VA-1400VA





See us at COMDEX/Fall, Sands Expo #\$3019F3



Standby UPS 300VA-1200VA

CE D AGS

MAIN POWER ELECTRONICS CORPORATION

E-MALL: impower@ipis1.seed.net.tw www.upstaiwan.com.tw

Internet-Server Bandwagon

re you looking for powerful but lowercost Web servers? Check out Taiwan. Local companies are beginning to get a foothold in the fast-growing Internet-server business with a range of low-cost CISC- and RISC-based systems.

Acer, Tatung, Umax, and other Taiwanese companies are shipping servers for handling TCP/IP data traffic jams on the Internet. Like the PC-clone makers in Taiwan, however, the Internet-server manufacturers generally price their hardware lower than the more famous U.S. names such as Apple, Hewlett-Packard, IBM, Sun, and others.

"We charge 10 percent to 15 percent below competitive systems from Apple," says a spokesman from Umax, Taiwan's largest scanner company that also entered the Macclone business last year.

Meanwhile, Tatung will move into volume shipments with its latest Web workstation and servers, which are based on the 64-bit UltraSparc processor. Tatung offers two Web machines, the CompStation U140-i and U170-i. They support the 143- and 167MHz UltraSparc chips, respectively. Both systems are designed for power-hungry but price-sensitive Internet service providers (ISPs) and Java applications developers, a spokeswoman says.

You can mix and match the system components and peripherals, but a standard configuration for both systems is 32 MB of memory, a 1-GB hard drive, Turbo GX graphics, and a 20-inch color monitor. Models also offer three SBus slots, a 10Base-T Ethernet interface, and other options. Another key to the Tatung machines is the Ultra Port Architecture-a high-performance interconnection that provides transfer rates of up to 1.3 Gbps, making it ideal for TCP/IP data traffic jams. Both systems come with software to access the Web, including SunSoft's Internet Gateway Server 1.0, Netscape's FastTrack Server, and Solaris 2.5.

Acer is making a push in the Web-server market with its AcerAltos 19000, based on a single- or dual-Pentium Pro processor. The 19000 runs a TCP/IP package under SCO Unix, NetWare, and Windows NT.

for the international markets with its U.K.based subsidiary, ICL.

Still, the question lingers: Will the Asian PC vendors dominate going into the next century? They have an advantage in their closer geographical and sometimes ethnic ties to some of the faster-growing markets in the region, including China, India, and Indonesia.

It will take vast resources to survive the cutthroat PC business, a market that favors the big conglomerates in Japan and Korea. Not all will survive. Hong Kong's PC vendors have nearly disappeared, while companies in Singapore are focusing on niche markets. China's PC vendors are not a factor outside their country.

Korean PC Market **Domestic PC Growth** 3.0 2.5 2.0 1.5

Growth of Korea's domestic PC market in terms of unit volumes.

The shakeout in the PC business has already taken place in Taiwan. Acer is the only vendor remaining with worldwide brand name recognition. Most of the remaining PC players in Taiwan build products for OEMs.

The survivors in the PC business have some common traits, including strong technology, distribution, and brand name recognition. Says IDC Japan's Umeyama: "To be successful, a company needs to be strong in all three areas." B

WHERE TO FIND

Acer, Inc. Taipei, Taiwan R.O.C. +886 2 545 5288 fax: +886 2 545 5308 http://www.acer.com/

Asustek Computer, Inc. Taipei, Taiwan R.O.C. +886 2 894 3447 fax: +886 2 896 7761

First International Computer, Inc. Taipei, Taiwan R.O.C. +886 2 717 4500

fax: +886 2 714 8676 http://www.fic.com.tw/

Fujitsu Ltd. Tokyo, Japan +81 44 754 8577 fax: +81 44 754 8554 http://www.fujitsu.com .jp/index-e.html

GVC Corp. Taipei, Taiwan R.O.C. +886 2 755 2226 fax: +886 2 755 2513 twang@gvc.com.tw

Mark LaPedus is a BYTE contributing editor based in Taipei. You can reach him by sending e-mail to 5916955@mcimail.com.







336RX TA717 New V.34bis 33,600bps SERIES

- 33.6k bps modem with 14.4k bps fax
- · Supports ITU-T V.34bis, V.34, V.32bis, V.32, V.22bis, V.23, V.22, V.21, Bell 212 & 103 standards
- DTE 115,200bps,DCE 33,600bps
- · With V.42bis, MNP5 Data compression
- · G3 Fax Compatible 14,400 bps send and receive
- . Data / Fax / Voice Function
- Worldwide PTT Approvals
- . Supports windows 95



Advanced Features:

- Basic Rate ISDN Access
- . Two Analog Ports Supported
- . High Speed V.24 Data Port up to 115,200bps
- · Asynchronous-to-Synchronous **PPP Conversion**
- V.120 and V.110 Rate Adaptation
- . X.25 on D Packet Data Application
- . Multiple Subscriber Numbering(MSN)
- · Calling Line Identification Security
- · Easy-to-Configure AP Supported
- 10 LED Status Indication





Subscriber Line Digital Multiplexer

Advanced Features:

- · Optional Network Management System
- · Low Power Consumption
- No Remote Battery Needed
- · Flexible Alarm System
- · High Voice Transmission Quality
- Fax and Modem Channel Quality
- · Easy Maintenance
- Freely Mix 1+1, 1+3 and 1+7 in COT



Advanced Features: · Low Cost, HDSL Transmission Technology

- · Repeaterless E1 / T1 Service, Connects at
- Distances Up To 6 KM (E1) / 7.2KM (T1). Modular Design, Easy Installation and Maintenance.
- Fiber Optic Quality Over Existing Copper Cable Multiple Interface Options .
- Network Management System for Remote Monitoring.

Circle 738 on Inquiry Card (RESELLERS: 739).













See us at Comdex Fall '96 November 18-22 **Booth NO: Hilton Convention** Center H1100





30, R&D Road 2, Science-Based Industral Park, Hsin-Chu, Taiwan, R.O.C. TEL: 886-35-774991 • FAX 886-35-777751 internet: http://www.e-tech.com.tw E-Mail:service@ml.e-tech.com.tw

VISUAL BASIC 3 ADD-ONS

VI	SUAL BASI
Comms - Async	:
Fax Plus for Win FaxMan SDK	£175 £390
Comms - Netwo	rk
Distinct TCP/IP Visual Intern dsSocket 1.25 Intro	et £265 £65
Database	
ADE/VBX Smithware VBX for Btrieve VB/ISAM MU for Win 16-bit	£350 £180 £145
Graphics - Charti	ing
Chart FX 3.0 (16-bit only) Charting Tools for Win - VB Real-Time Graphics Tools - VBGraphix	£210 £180 VB £300 £270
Graphics - Image I	Files
Image SDK Plus/VBX 2.0 ImageKnife/VBX Std 2.0 ImageMan/VBX 5.0	£250 £200 £230
Mutti-Function	60
Borland Visual Solutions Pa Designer Widgets 2.0 Muscle (Win)	ck £59 £99 £125

PROGRAMMING

Visual Developer's Suite (16 bit) £216

£130

£115

£160

VBlite 1.0

VBTools 4.0

WinWidgets/VBX

ools
Assemblers
C/C++
Cross Dev
Database
Delphi
Fortran
GUI
Lisp
Multi-tasking
Prolog
SQL
Visual Programming
Xbase

We stock many items for which there is no space in these advertisements. C++ COMPILERS

Borland C++ 5.0	£245	
Borland C++ Dev Suite 5.0	£337	
BC++ Dev Suite + Des Tools	CALL	
MS Visual C++ Subscription 4.1	£399	
MS Visual C++ Standard 4.0	£59	
Optima++ Developer Intro	£139	
Salford C/C++ Win Dev	£395	
Symantec C++ 7.2	£375	
Turbo C++ for Win 4.5	268	
VisualAge for C++ 3.5 w/Docs	£326	
Watcom C/C++ 10.6 Intro	£145	
High C/C++ for Ext-DOS/Win Salford C/C++ DOS Dev Turbo C++ 3.0	£620 £195 £66	

DELPHI

Delphi Desktop 2 Delphi Developer 2 Delphi Client/Server Suite 2	£245 £390 £1260
ABC for Delphi 1.0b	£99
Apiary Dev Suite for NetWare	£195
Asynch Pro 2.0 for Delphi	£135
Borland RAD Pack for Delphi	£125
Charting Tools for Win - Delphi	£180
Component Create	£155
Conversion Assistant Database	
Eschalon Power Controls	€98
Helping Hand for Delphi	£150
HyperTERP/Delphi	£120
ImageLib 16-bit	£109
InfoPower 2.0	£179
InnoView MultiLanguage	£125
KingCalendar Pro	£65
List & Labels for Delphi 3.5	£295
Mobius Draw Kit	£99
Mobius FastSprites	£105
OCX Expert	£195
Orpheus	£135
Pumpkin Project Manager 2.0	583
Real-Time Graphics Tools	£360
Transform: Component Expert	£125
VisualPROS 1.1	£119
WinG Sprite Kit	£99

Sundry Components

CADControl	£365
d-Barcode VBX/DLL	£94
VB/Magic Controls	£120
Visual CAD Dev Kit	£520
Sundry Controls	
	- Table 1

3D Graphics Tools 4.0	£130
EDI-VBX 1.0	£705
Gantt/VBX	£195
MediaKnife/VBX	£290
VBX Artist	£240
Visual Instrument Panel Cntrls	£150
VideoSoft VSView/VBX	£105

Text Editor Controls

ire fort outflor ofaridara	
Tools	
SpyWorks-VB 2.1	£100
TMP Tools 1 1	coc

VBAssist 3.5 VB/DLL 2.05

C

GO

C G

PF

VERSIONS/VB 1.1

Prices do not include VAT or other local taxes but do include delivery in mainland UK. Please check prices at time of order as ads are prepared some weeks before publication.

This page lists some of our products - call us for a complete price list ORDER BY PHONE WITH YOUR CREDIT CARD

(01364) 654100 FAX: (01364) 654200

COBOL

This is probably the most advanced COBOL compiler in the world.

VisualAge for COBOL for Win CALL VisualAge for COBOL for OS/2 £599

£625

£295

£200

£289

£755

£365

£78

C & C++ FOR WINDOWS

2140

£165

Comms		Graphics & GUI	
sync Pro for Win 2.1 OMM-DRV/LIB 16.0 ax C++ SDK for Win16/95 reenleaf CommLib 5.2 nNet SDK 4.0	£135 £105 £770 £235 £370	3d Graphics Tools 5 (32-bit C) ProtoGen+ Pro for Win32/16 WinGKS WinMaker Pro 6.0 zApp	£230 £415 £575 £725 £575
Compression	2070	Zinc Engine & Win16/32 Key	£634
rusher! Win DLL w/Source reenleaf ArchiveLib 2.1 KWare Data Comp Lib for Win COMP/Multi-Platform 2.12	£235 £210 £175 £105	Maths & Stats IMSL C Numerical Libraries IMSL Math Module for C++ Math.h++ 5.1.3	£495 £495 £495
Database		Money.h++	£1075

CodeBase 6.0	£270	Sundry Components	
CXBase Pro	£500	C++ Booch Components	£415
DBTools.h++ for ODBC	£1250	HeapAgent 16 & 32-bit Combo	£655
DISAM96 for DOS/Win	£715	TG-CAD Prof 6.0	£1235
List & Labels for Win (Pro)	£410	Tools.h++ 7.0	£340
POET Personal SDK 4.0	£649	WinWidgets++	£240
ProtoGen+ Client/Server Win	£1470	Tools	
Raima DBM Engine+EADS 4.0	£740	CC-RIDER for Win16	£250
Velocis + EADS (Offer)	£250	CC-RIDER for WILLIO	DCSI

KPWin++

Newi Solo Intro

Visual Parse++

SOMobiects Dev Toolkit

Visual Basic Enterprise 4.0

Visual Basic Standard 4.0

Visual Basic Professional 4.0

VISUAL BASIC 4

£990

Graphics - Charting

Velocis + EADS (Offer)

Visual SQL

GX Sounds

C-DOC Pro 6.0

MTASK

Charting Tools for Win 2.0	£180
Essential Chart for Win	£275
GraphiC/Win 7.0	£360
Graphics Server 4.0	£245
Real-Time Graphics Tools	£360

Graphics - Images

Ad Oculos (Image Analysis) 2.0	£325
Image SDK Plus for NT	£505
ImageKnife Pro 2.0	£280
ImageMan DLL 32 & 16-bit 5.0	£620
LEADTOOLS Win32 Pro 6.0	£715

General & Systems Libraries

Tools

TTSR Ram Res Dev Sys 2.03

C-Vision for C/C++ 4.0 CodeCheck (Professional)

PC-Lint for C/C++ 7.0

Ad Uculos (Image Analysis) 2.0	£325	The state of the s	
Image SDK Plus for NT ImageKnife Pro 2.0 ImageMan DLL 32 & 16-bit 5.0 LEADTOOLS Win32 Pro 6.0	£505 £280 £620 £715	3d Graphics Tools 5 (32bit VB4) Apiary Dev Suite for NetWare AutoCoder BetterState Pro w/VB CodeGen ButtonMaker	£149 £195 £55 £249 £75
C & C++ FOR DOS		ClassAction (VB4)	£110
Comms		ClassAssist (inc Oblets) CodeBank (VB3/4) Code Complete	£175 £88 £175
Essential Comm 5.0 MagnaComm/DOS SilverComm "C" Asynch 4.06	£235 £215 £210	Crescent Internet ToolPak 2.0 Designer Widgets 2.0	£135 £99
Database		EnQuiry 2.0 (VB4) ERwin/Desktop for VB4	£199 £399
c-tree Plus 6.5A	£565	GeeWiz 2.0	£75
SoftFocus Btree/ISAM	£75	Helping Hand for VB	£150
Graphics & GUI		Into Code (VB4) List & Labels for VB3/4 3.5	£55 £295
3D-Ware Prof Fastgraph 4.0 (Ted Gruber) GX Graphics 3.0 MetaWINDOW-DOS 5.0 Zinc Engine & DOS Key 4.1	£99 £195 £155 £215 £634	PowerPak Enterprise for VB4 PowerPak Professional for VB4 SplashWizard Spyworks - Prof 4.0 (inc Sub) Tear Off Menus for VB4	£925 £505 £75 £225 £115
Maths & Scientific		VB AppFramework	£159
C/Math Toolchest & Grafix Huge Virtual Array & NAT 3.0 Science, Eng & Graphics Tools	£45 £215 £115	VB Assist 4 VB Compress Pro 4.0 VB Language Manager Pro 3.0	£130 £98 £132
Screen		VB/FailSafe Pro Vision StoryBoard 4,0 (VB4)	£195 £175
C/Windows Toolchest Greenleaf Datawindows 3.0 TCXL UI for DOS/Win 6.2	£45 £225 £135	Visual Bridge (Access → VB4) Visual Expert Developer XREF 2.0	£89 £250 £95

VISUAL BASIC FOR DOS

ı	MS Visual Basic for DOS Std MS Visual Basic for DOS Prof	£100 £240	
l	db/Lib Prof 3.0 Graphics Workshop	£195 £105	
I	PDQComm 2.62	£85	
ł	ProBas 7.1 QuickPak Pro 4.19	£210 £145	
۰	QUICKPAK Pro 4.19	£140	

News & Views

JAVA WORKSHOP

And Now Far Something Completely Different!

Is this the first of a new generation of software development tools? Sun's new Java WorkShop is the first loof that runs in a Web browser - if you can browse the Web, you can use Java WorkShop! It includes everything you need to visually assemble and publish portable Java

- Web Browser IDE written entirely in Java lets you switch between tools as easily as browsing web pages.
- Integrated Toolset that works
- Visual Java GUI Builder is very easy to use, automates creation of applet or app user interface. Over a dozen AWT widgets, add your own. Layout & Preview modes let you test immediately. Generalize the services and account of the control o
- Source Browser displays class hierarchy, creates links to constructors & methods
- Source Editor is easy to use, edit multiple files, integrates with RCS & PVCS for team programming
- Debugger lets you debug applets on HTML pages or standalone apps. locally or remotely across the net.
- Applet Tester lets you test applets
- Project Manager organises all the
- **Build Manager** automatically builds
- Portfolio Manager lets you create & organise personal portfolios of applets, and share them with others
- Online Help gives detailed hot-linked explanations of each tool

Java WorkShop is available at a very special price until the end of the year-why not call us for more details on one of the most exciting software development tools of the year

GEOPOINT

Add GIS Functionality

GeoPoint is a 32-bit ActiveX Control that displays date of all kinds by thematically shading the polygons of Maplino and AutoCAD drawings. Now you can add the power of standatone geographic information systems to your custom applications. It consists of two controls:

- Map Shader Control links to a data source & uses an intelligent binning algorithm to sort & divide the data into categories. Shading of polygons is performed based on these categories
- Legend Control identifies the categories and helps the user interpret the map shading

If you manipulate geographic data in your apps, call us for more details about this exciting package - pricing is very competitive at £180 + VAT.

LOW PRICES

MICROSOFT & BORLAND

MS Fortran PowerStation Std 4	£485
MS Visual Basic Std 4.0	£78
MS Visual Basic Prof 4.0	2365
Microsoft Visual C++ 4.0	£399
Borland C++ 5.0	£245
Delphi Desktop 2	£245
Delphi Developer 2	£390
Paradox for Win95 7.0	€92
Turbo C++ for Win 4.5	£68
Visual dBASE 5.5	€260

WITH FULL TECHNICAL SUPPORT

BASIC LANGUAGE

PowerBASIC Pro (Win&DOS)	£210
PowerBASIC DLL Compiler	£106
XBasic Pro (Win32)	£199

£165

P215

£100

£240

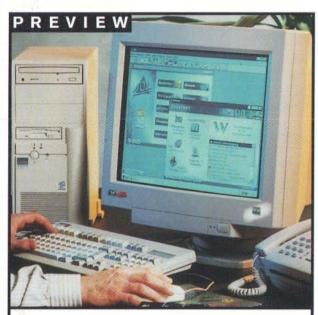
£145 €475

£135

What's New

Hardware

This month's lineup features desktop data mining, complete communications, and forms processing.



miroMedia Online

Price: DM 399 (plus DM 119 for the radio upgrade)

Circle 988 on Inquiry Card.

miro Computer Products AG

Braunschweig, Germany +49 531 21130 fax: +49 531 211399 http://www.miro.de

Communications Command Center

The big strength of the miroMedia Online communications package is its versatility. The product is a hybrid V.34 modem and sound card that's based on IBM's Mwave DSP technology. In combination with intelligent media management software, the board works as the command center for all your PC communications needs.

The package provides a complete phone subsystem, includ-



ing a speakerphone, voice mail, and an answering machine. The included fax software offers integration with Microsoft Exchange and fax-forwarding functionality. Also, its Digital Simultaneous Voice and Data (DSVD) features let you speak to a remote collaborator and

share applications at the same time over the same phone line.

The wave-table sound subsystem allows for good-quality audio recording, playback of audio CDs, and sound editing. The system can be upgraded via an FM radio-receiver piggyback board that enables digital audio recording directly to a hard disk.

-Rainer Mauth

Storage

Portable Hard Drive Connects to PC Card Slots

THE DISKMAN, A COMPACT, PORTABLE 2½-inch hard drive, offers a fast and reliable way to increase the hard disk storage of your PC or notebook. The device connects to any PC's parallel port or PC Card slot and can store up to 1.39 GB of data. It's highly shock-resistant and easy to carry, and it offers a pass-through for concurrent disk access and printing.

Price: 810 MB, £329; 1.39 GB, £429. Opti International, Ltd., Barking, Essex, U.K., +44 181 507 1818; fax: +44 181 594 2235; 100517 @compuserve.com.

Circle 990 on Inquiry Card.

High-Speed Hard Disks for Mobile Computers

THE ROBUST TRAVELSTAR 2LP 51/4-inch hard drives are optimal devices for mobile computers: They measure 12.5 mm high and weigh only 140 grams. These devices use IBM's Adaptive Battery Life Exten-



der technology and can store up to 2.1 MB. With a 128-KB cache and DMA-mode-2 functionality, they achieve data transfer rates up to 16.6 Mbps.

Price: Starts at DM 320 for

540 MB. MCE Computer Peripherie GmbH, Ottobrunn, Germany, +49 89 609 10 86; fax: +49 89 609 20 17. Circle 989 on Inquiry Card.

RAID-1 Controller for IDE Drives

AC-MIRROR, A FAULT-TOLERANT RAID-1 IDE controller, makes an efficient data-security solution for single PCs. The product has the ability to work with as many as four hard drives of different capacities. The AC-Mirror system, which requires no driver software, supports DOS, Windows, NetWare, OS/2, and most Unix flavors.



Price: DM 300. Hantz & Partner GmbH, Gundelfingen, Germany, +49 761 592100; fax: +49 761 585228; 100431.2606@compuserve.com.

Circle 991 on Inquiry Card.

High-Speed SCSI RAID Controllers

ICP VORTEX'S NEW GDT6000 LINE of fast and wide SCSI disk-array controllers offers complete RAID functionality from level 1 through level 5. These PCI boards achieve data-transmission rates as fast as 40 Mbps in synchronous mode. They have the ability to operate in mixed 8- and 16-bit environments and come in one- and two-channel versions. In addition, drivers for all standard OSes, including Linux, are available.

Price: Call company. ICP Vortex Computersysteme GmbH, Flein, Germany, +49 7131 5972 0; fax: +49 7131 2550 63; info@vortex.de. Circle 992 on Inquiry Card.

Systems

Do MPEG-2 on Your Desktop

THE MPEG PFW 6000 IS A 166-MHZ Pentium machine that has the ability to convert video into MPEG-2



half D-1 or full D-1 format. The system includes 32 MB of RAM, a 4-GB hard drive, four RISC chips on two separate PCI boards, a dedicated MPEG-2 playback board, a PC-based scope, and a digital noise filter. With this workstation, you can produce MPEG-1 for video CD and MPEG-2 video streams with 704- by 576-pixel resolution and 15-Mbps data streams.

Price: Starts at DM 99,900. APE Ptacek Engineering GmbH, Munich, Germany, +49 89 630209 0; fax: +49 89 630209 90.

Circle 996 on Inquiry Card.

Low-Cost PC

FIRST INTERNATIONAL COMPUTER'S LEO Titan 995 is a fully functional PC that sells for less than \$1000. The system is built around AMD's K5-PR90 microprocessor, an x86-based Pentium-level chip. The Leo Titan 995 comes with 8 MB of memory, 256 KB of Level II cache, 1 MB of video memory, a 14-inch monitor with 1280- by 1024-pixel resolution, 1.2 GB of hard disk space, a six-speed CD-ROM drive, 16-bit sound, speakers, and OS software. *Price: Call company. First*

International Computer, Inc., Taipei, Taiwan, R.O.C., +886 2717 4500 ext. 7051; fax: +886 2714 8676; http://www.fic.com.tw/. Circle 997 on Inquiry Card.

Workstation for Industrial Control Systems

ADVANTECH'S MIPC-70CT WORKSTAtion is designed for embedded and industrial control systems, such as instruments and other equipment. The MiPC-70CT has an openframe architecture to provide flexibility for end users. The system also comes with a 10.4-inch TFT LCD with 640- by 480-pixel resolution and offers simultaneous support for a VGA monitor and flat-panel displays. The MiPC-70CT workstation, which is built around an allin-one PC motherboard based on either a 486 or a Pentium processor, comes with a 21/2-inch hard drive. A three-slot ISA-bus expansion kit is optional.

Price: Call company. Advantech Co., Ltd., Taipei, Taiwan, R.O.C., +886 2 218 4567; fax: +886 2 218 4566. Circle 998 on Inquiry Card.

Communications

New Fax-Testing Boards for Product Developers

ASPECT 4G, A DEDICATED FAX-PROtocol testing board, includes Windows software that runs preprogrammed tests, manages private protocols, and passively observes protocols. The system can analyze V.34 modulation, V.8 frames, and compatibility with T30 and T4. The



product is designed for regulatory organizations, test laboratories, and product developers. Price: Call company. KTT, Fontenay-sous-Bois, France, +33 1 43 94 0505; fax: +33 1 43 94 9161; info@ktt.fr; http://www.ktt.fr.

Videoconferencing

Circle 993 on Inquiry Card.

ISDN and LAN Video Communications

A VIDEOCONFERENCING SYSTEM THAT SUPports the H.320, H.323, and T.120 standards, the ViPA-I2 is an ISDN and LAN multimedia conferencing system for the PC. It allows you to make and receive calls across an analog or ISDN telephone network. An outgoing phone call can be configured as either video- or speechonly. The data-conferencing software lets you share an application and transfer files.

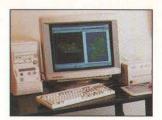


Price: Call company.
Loughborough Sound Images
plc, Loughborough, U.K., +44
1509 634300; fax: +44 1509
634333; sales@lsi-dsp.co.uk;
http://www.lsi-dsp.co.uk.
Circle 994 on Inquiry Card.

Scanners

Raster-Image System for Cartographers

DIGIMAP 3D IS A COMPLETE PACKAGE for producing raster images and digital terrain models from paper maps, satellite images, aerial photographs, and digital files. This Windows system has a 32-bit graphics



kernel and simultaneously manages multiple layers of cartographic information in any type of projection. Other features include data extraction, geocoding, terrain-data interpolation, and geographic transformation. System hardware includes a large-format color scanner, a CD-ROM recorder, and two 166-MHz Pentium PCs. Price: Call company. ATDI, Paris, France, +33 1 40 07

Printer Interfaces

0440; fax: +33 1 40 17 0477.

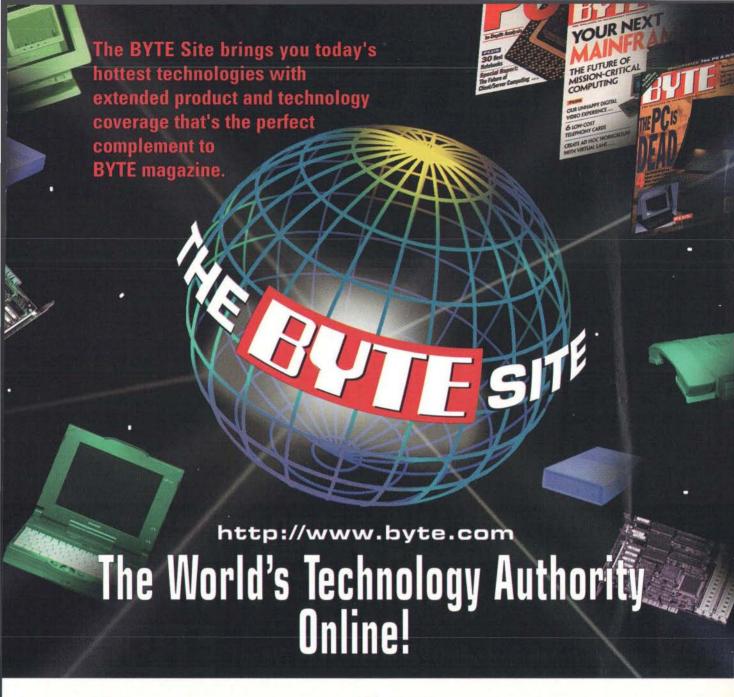
Circle 995 on Inquiry Card.

Speedy Infrared Printer Interface for Data Transfer

INTERCON-INFRAPRINT, AN INFRARED printer interface for all parallel printers, provides notebook computer users with an IRDA-compatible infrared sensor to transfer data without cable connections. It sends data at rates up to 115 Kbps across distances up to 1 meter. The device automatically switches between the infrared sensor and the normal parallel ports, so no data can get lost.



Price: DM 395. SEH
Computertechnik GmbH,
Bielefeld, Germany, +49 521
94 22 60; fax: +49 521 44
40 49; rcl@seh.de;
http://www.seh.de.
Circle 1000 on Inquiry Card.



The BYTE Archive

Two years of BYTE, more than 3,000 full-text articles, illustrations, and photos... all indexed for quick retrieval!

■ The BYTE Network Project

The BYTE Site... a living laboratory showcasing the best tools for building Web applications. Read about it in BYTE... try it out online!

The Virtual Press Room

Instant access to vendor press releases and white papers! Links to vendor web sites!

BYTEMarks

FREE Benchmark! Download the BYTEMark – the benchmark with teeth!

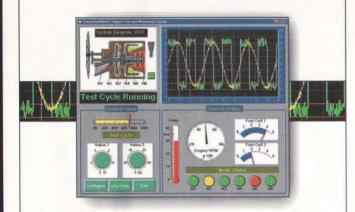
Direct Access to Advertisers

Contact Byte advertisers DIRECTLY through the online advertiser index!



The BYTE Site. The World's Online Technology Authority.

Instrumentation Software News



New LabVIEW® 4.0 - Graphical Programming

- High-powered productivity tools for fast development
- Graphical compiler for optimized execution speed
- FlexVIEW user-configurable environment

New LabWindows*/CVI 4.0 - Tools for C/C++

- Easy-to-use GUI editor, C program-generation tools
- More than 600 GPIB and VXI instrument drivers
- Works with Visual C++, Borland C++, WATCOM, and Symantec

New ComponentWorks™ - ActiveX Controls for Visual Basic

- OLE controls for analog and digital I/O
- User interface OLE controls (graphs, knobs, meters, more)
- Works with Visual Basic, Visual C++, and Delphi

New VirtualBench™ - Turnkey Virtual Instruments

- Turnkey, PC-based virtual instruments
- Oscilloscope, function generator, DSA, DMM, data logger
- Runs on Windows 95/3.1 with our DAQ products

New Measure™ - Direct Data Acquisition for Excel

- Acquire data from DAQ boards or serial instruments
- Easy-to-use configuration panels no programming
- Data values placed directly into spreadsheet cells

Call for your **FREE** evaluation copies of these software products on our Software Showcase CD.





European Branch Offices: Austria 0662 45 79 90 0 • Belgium 02 757 00 20 Denmark 45 76 26 00 • Finland 90 527 2321 • France 1 48 14 24 24 Germany 089 741 31 30 • Italy 02 413091 • Netherlands 0348 433466 Norway 32 84 84 00 • Spain 91 640 0085 • Sweden 08 730 49 70 Switzerland 056 200 51 51 • U.K. 01635 523545

U.S. Corporate Headquarters • Tel: (512) 794-0100 • Fax: (512) 794-8411 E-mail: info@natinst.com • WWW: http://www.natinst.com

© Copyright 1996 National Instruments Corporation. All rights reserved.

Product and company names listed are trademarks or trade names of their respective companies.

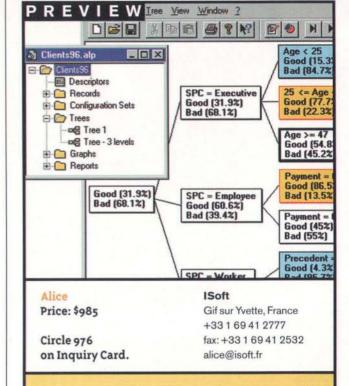
SOFTWARE

Telephony

WinPhone+ Adds Calling to Windows Applications

THE LATEST VERSION OF WINPHONE+ works with standard World Wide Web browsers and automatically dials any number appearing on a Web page. In addition, the telephony program can dial out of any standard DOS, Windows 3.x, or Windows 95 program and is compatible with Windows NT 4.0. Win-Phone+ reveals details of inbound calls and suggests best dial-out times based on tariff information. It also communicates with standard palmtop computers and supports GSM Short Message Service (SMS).

continued



Data Mining for Business Users

inally there's a program that can bring data mining to your marketing department's desktops. Alice, a streamlined version of ISoft's decision-tree-based AC² data-mining product, is designed for mainstream business users. It's a major step on the road toward easy-to-use and easy-to-understand data mining.

With Alice, you select a data source—a spreadsheet, a database, or the output of a statistical package—and point at the field you want to analyze. This Windows 95 application then uncovers the patterns behind the data. Like AC², it represents results in decision trees, giving you a good grasp of the basic correlation and allowing for an easy check of hypotheses.

Of course, there are trade-offs. Don't expect fine-tuning or validation facilities. And you can't specify the properties and parameters of an analysis or cross-validate the results. But most marketing users don't require such features.

Alice provides an intuitive and quick way to discover the secrets that underlie complex databases. For users who need more specific features for certain application fields (e.g., risk evaluation), ISoft plans to offer vertical add-ons to Alice.

—Rainer Mauth

Introducing Great Visual Color!

Announcing GVC's CREAVISON professional color monitor series!

In today's graphical computing environment, a high quality affordable monitor is essential in keeping up with the demands of 3D graphics, animation, and Internet browsing.

GVC's new line of professional monitors offer you state of the art features such as On Screen Display (OSD) for easy adjustment. Our high-resolution, high-contrast screens bring you exceptionally vibrant colors and crystal clear images.

More importantly, from our extensive experience as a world-wide top tier OEM supplier, we are able to provide you with exceptional values!

To find out more, please contact us at 8F, 80, Sec. 2, An-Ho Road, Taipei, Taiwan, R.O.C. Tel:886-2-701-2226 Fax:886-2-704-0338 E-Mail:monitor@gvc.com.tw





Come visit us at COMDEX Fall, Booth #: S-3544

Model	CRT type	Horizontal Frequency	Vertical Frequency	Resolution (Max.)	Front panel control	Option
M1448	14"/0.28	30-50KHz	50-90Hz	1024x768	analog	
M1450	14"/0.28	30-50KHz	50-90Hz	1024x768	digital	speaker
M1558	15"/0.28	30-56KHz	50-90Hz	1024x768	analog	
M1565	15"/0.28	30-69KHz	50-90Hz	1280x1024	digital	speaker
M1568	15"/0.28	30-69KHz	50-90Hz	1280x1024	digital OSD	
M1764	17"/0.39	30-69KHz	50-90Hz	1024x768	digital	speaker
M1765	17"/0.28	30-69KHz	50-90Hz	1280x1024	digital OSD	speaker
M1785	17"/0.26 Diamondtron	24-85KHz	40-100Hz	1600x1200	digital OSD	speaker



GVC CORPORATION DISPLAY BUSINESS UNIT





FCC BZT DHHS () (E







To Subscribe to BYTE magazine, or for Customer Service, contact your local BYTE Subscription Representative:

Benelux

Gerry Westerhof

Phone: 31 72 509 1855 Fax: 31 72 509 1145

Bulgaria

Daniel Christov

Phone/Fax: 359 2 974 3557

France

Eric Le Quinio

Phone: 33 1 49 77 03 06 Fax: 33 1 43 76 74 29

Germany, Austria, Switzerland

Wolfgang Brezina

Phone: 49 89 525 847 Fax: 49 89 529 850

Greece

Maria Hadjioannou

Phone: 30 61 620384 Fax: 30 61 272072

Hungary Imre Szabo

Phone: 36 76 488888 Fax: 36 76 488889

Ireland

Ian Bangham

Phone: 353 1 280 7133 Fax: 353 1 280 7157

Italy

Enrico Campia

Phone: 39 11 8127656 Fax: 39 11 8994422

Middle East Zafar Inamdar

Phone: 971 4 666788 Fax: 971 4 621149

Poland

Wlodek Bincyzk

Phone/Fax: 48 2 625 2275

Portugal

Manuel Neves

Phone: 351 1 3479301 Fax: 351 1 3475127

Scandinavia

Gunnar Sandbjerg

Phone: 45 3314 2226 Fax: 45 3314 2218

or Lauge Dehn

Phone: 45 86 223188 Fax: 45 86 228159

South Africa

Cape Town: J Trisos

Phone: 27 21 24 4094 Fax: 27 21 24 8681

Durban: T Tyson

Tel: 27 31 2027303 Fax: 27 31 2027307

Johannesburg: M Kendrick

Tel: 27 11 8804988 Fax: 27 11 4428327

Spain

Barcelona: Javier Casellas Phone/Fax: 34 3 2380342 Madrid: Eduardo Montojo Phone/Fax: 34 1 5716685

or Henri Misrahi Phone: 34 1 7337346 Fax: 34 1 7338970

Turkey

Cengiz Eren

Phone: 90 216 345 3473 Fax: 90 216 346 2464

United Kingdom

Peter Greason

Phone: 44 1 61 430 3423 Fax: 44 1 61 494 6976

or John Luker

Phone: 44 1 258 821114 Fax: 44 1 258 821115

If there is no BYTE representative listed above for your country, please contact:

BYTE Subscriber Services:

PO Box 72, Galway, Ireland. Fax: +1 353 91 752793. Phone: +1 353 91 752792.



A Division of The McGraw-Hill Companies



Forms Processing

loons automatically dial via Windhone and Expend Data to Hitlineursh. ACT for Windows. ACT

Price: DM 199. MegaSoft GmbH, Wien, Austria, +43 1470 2022; fax: +43 1470 2022 77; herbert@megasoft .co.at; http://www.megasoft .co.at.

Circle 979 on Inquiry Card.

CTI Applications Development Tools

RHETOREX EUROPE IS OFFERING A NEW starter version of its Visual Telephony kit for Windows 95 and NT. The kit's development tools support up to 30 ISDN lines and let users develop multichannel voice-processing applications, such as voice



mail, automated attendants, interactive voice response, audiotex, and predictive dialers.

Price: Starts at £599. Rhetorex Europe, Ltd., Bracknell, U.K., +44 1344 380280; fax: +44 1344 301067.

Circle 977 on Inquiry Card.

Add CTI to Windows Applications

DESIGNED FOR ORGANIZATIONS THAT want to add telephony to their applications, Telephony Toolbox enables developers to write TAPI-or TSAPI-compliant drivers in less than an hour. The software package comes as a 16- or 32-bit DLL, VBX, or VCL.

Price: £350. QBS Software, Ltd., London, U.K., +44 181 956 8000; fax: +44 181 956 8010; skye@qbss.co.uk.

Circle 978 on Inquiry Card.

Electronic and Printed Forms Processing

OFFICE FORMS' DATABASE LINK WIZard provides a new way for organizations to handle their electronic and printed forms and is compatible with Microsoft Office 95. Forms can be compiled into an EXE file so that persons outside the company



can supply data (a run-time version in the EXE file is all that's needed). Distributed forms can include validation checks, calculations, and user-defined help on how to fill out the form.

Price: £40 per seat. Toplevel Computing, Ltd., Gloucestershire, U.K., +44 1453 753955; fax: +44 1453 753933.

Circle 980 on Inquiry Card.

QA Control

Audit Your Safety Strategies

ASM QUICK SCAN, A PROGRAM FOR advanced safety management in the chemical and processing industries, lets you evaluate your organization's safety strategy via a questionnaire. It covers such topics as line responsibility, clear and positive relationships with contractors, and realistic safety targets. The tool helps improve the quality standards of organizations and installations.

Price: Call company. Mathcomp, Voorburg, The Netherlands, +31 182 632811; fax: +31 182 612654.

Circle 981 on Inquiry Card.



Circle 736 on Inquiry Card (RESELLERS: 737).

HyperMedia Professional

intelligent large-scale management of any type of information

☐ information retrieval retrieval by any combination of words and, or, not, proximity and adjacency dates and numbers with range queries support for most wp formats

support for structured data 2+Gb text bases currently in operation

□ object-oriented hypermedia multilevel multimedia dossiers manage any type of digital data links automatically established during input

or manually at any time full link control

documents

☐ monochrome rasters

A0 formats and over TIFF CCITT G4 compression software compression and decompression certified Kofax support for fast scanners duplex scanning in software multiple raster layers anchors (hot spot links to multiple documents)

retrieval through queries on anchored

☐ color and grayscale images software ISO-JPEG compression multiresolution images miniature previews conversion and print

□ COLD output

automatic archival for mainframe print spools with indexing and document separation image synthesis of spool data over a raster background storage cost as low as \$1 per 15,000 pages

☐ full protection

□ extensive customizing

☐ network, optical disks and iukebox support

☐ and more...

special version for CD-ROM dissemination

available on Microsoft Windows Microsoft Windows NT (Intel and Alpha) UNIX (DEC Alpha, IBM Risc/6000, HP PA RISC)



Internet: http://www.hypersystems.com

GET IT DONE WITH OEW FOR JAVA™



http://www.isg.de/OEW/JAVA

isg Innovative Software GmbH Germany @ +49 69 236929 Fax +49 69 236930

Data Acquisition

Process Monitoring and Sequence Control

WINDMILL IS A SUITE OF DATA ACQUISItion and control software. It can log data to disk at up to 200 samples per second. The program runs under all Windows flavors; handles over 100 input and output channels; and integrates Ethernet, GPIB, Modbus, RS-232, and RS-485 devices. Applications include process mimicking, logging, charting, alarm monitoring, and sequence control. Price: Starts at £375. Windmill Software, Ltd., Manchester, U.K., +44 161 833 2782; fax: +44 161 833 2190: http://www.microlink.co.uk/ microlink/wmdemo.html.

Programming Tools

Circle 982 on Inquiry Card.

Database Forms

VTS DATAFORMWIZARD, A VISUAL BASIC 4.0 add-in, helps generate database forms and automatically creates Visual Basic code for forms processing. The product offers representation of n:1 relations, nested queries, fast searches, and error handling in case of invalid database fields. Price: DM 179, ToolShop GmbH, Kiel, Germany, +49 431 84625; fax: +49 431 85608; 100736.1520 @compuserve.com. Circle 983 on Inquiry Card.

Development Tool for POS Terminals

COMMPOINT HELPS YOU DEVELOP APPLIcations for point-of-sales termi-



nals. The development toolkit supports H.320 video telephony, TCP/IP, ISAPI, CGI, ODBC, and SQL. The software package works with touchscreen monitors, joysticks, DTMF encoders, and SmartCard readers. Price: Call company. TechLog, Düsseldorf, Germany, +49 211 9988336; fax: +49 211 9988343; TechLog@ combuserve.com.

Circle 984 on Inquiry Card.

Graphics Tools

Integrate Vector Graphics into HTML

WITH METAWEB, YOU CAN INTEGRATE scalable CGM vector graphics into any HTML document, thereby linking certain elements of the graphics with other documents. The software package, for Windows 3.x, comprises an authoring tool, a helper application, a Netscape plug-in for Windows Web browsers, and a CGM viewer. MetaWeb also imports and exports WMF files. Price: DM 100. Ematek Informatik GmbH, Köln, Germany, +49 221 5120 74;

gsscgi@ematek.de. Circle 985 on Inquiry Card.

fax: +49 221 5296 66:

Tools for Visualizing Matrices

AVAILABLE IN 16- AND 32-BIT VERSIONS, SimplePlot Visualization for DOS and Windows helps you draw surfaces, contours, lines, and polygons from matrices. The Motif version of SimplePlot allows for the interactive display of 3-D data and has an interface to the DOS/Windows version. The advanced version, SimplePlot Plus, includes C functions and FORTRAN routines for standard graphing and mapping projections. Price: Call company. Bradford University Software Services, Ltd., Bradford, U.K., +44 1274 841396; fax: +44 1274 841388; info@buss.co.uk; http://www.buss.co.uk/buss.

Circle 986 on Inquiry Card.



Mac Component Application

An OpenDoc word processor delivers on component software's promise of small, tightly coupled parts. By Tom Thompson

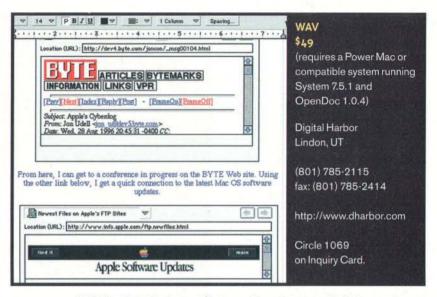
Componentized WAV of the Future

s Apple's cross-platform OpenDoc technology celebrates its first birthday, practical component software is starting to appear. One such component is Digital Harbor's WAV, which implements the bread-and-butter task of word processing. I saw a preliminary beta version. Currently, only a Power Mac version is available. As beta software, WAV has some rough edges and missing features, but it proves that OpenDoc's component-based architecture is sound.

At 1.5 MB, WAV offers a lean-andmean set of features. That's fine: I don't want unnecessary wizards and other "features" that contribute to code bloat. For text, you get basic formatting, where you pick a typeface, style it (bold, italic, underline, and a color), and align it with a few points and clicks. WAV has a simple word-count command, a handy feature if you write to length. It does have advanced layout facilities, such as arranging the text into columns (a maximum of five) and the ability to tinker with the text spacing. To readily get at existing text, WAV has conversion filters for WordPerfect 3.x, Word 4.x, and Word 5.x files.

A FolderBay function consolidates operations or content into virtual "folders" with clickable tabs at the top of the document window. Default folders are text functions, CyberDog (Apple's Internet tool suite), and a parts folder for additional OpenDoc components (e.g., a draw editor part or a bit-map editor part). You can add your own "project" folder tab to consolidate work documents.

As an OpenDoc component, WAV takes a document-centric approach to creating and handling data. You don't launch WAV itself. Instead, you open a WAV stationary (or template) file to make a new document. A Document Info command lets you set each document's file type (e.g., WAV format or ASCII text) and



WAV's tight Internet integration lets you build documents containing live updates.

memory size, so you can conserve memory by adjusting it to suit the document.

WAV integrates well with other Open-Doc parts. If you have CyberDog installed, its functions are immediately available from WAV's CyberDog tab. More important, you can drag and drop Internet uniform resource locators (URLs) and graphics from CyberDog into a WAV window, and save the information into a live document. When you next access the file, CyberDog automatically connects to the Internet and fetches the URL's current information.

For example, I have a WAV file that points to a conference on BYTE's Web site pertaining to CyberDog discussions. When I'm notified of new messages in this conference, I just open the WAV document, and I'm automatically positioned at the last-read message. Conventional Web browsers do this with bookmarks, but WAV does them one better: It lets you capture links, text, and graphics into doc-

uments, bypassing the usual download, file-conversion, and import stages.

Because OpenDoc components are small and tightly focused, development costs are lower. Thus, WAV costs only \$49. While you couldn't publish a book with



it, you can crank out sophisticated publications with embedded images, diagrams, tables, and charts—thanks to the OpenDoc components that make WAV greater than the sum of its parts. Also, WAV represents the future of on-line publishing, where you build documents with dynamic links to information on the Web. WAV has no equal in this area.

Tom Thompson is a BYTE senior technical editor at large. You can contact him at tom _thompson@bix.com. Alps' MD-4000 prints high-quality, high-resolution color images, indelibly and inexpensively. By Robert L. Hummel

Waterproof Color That Lasts

quality color printing, Alps Electric hopes that its new \$499 MD-2010 color printer and \$699 MD-4000 printer/scanner will ride the current wave of interest in PC-based photo-realistic imaging. Using Alps' thermal-transfer "Micro Dry" inks, these units print waterproof, high-resolution color images (600 by 600 dpi in color, 1200 by 600 dpi in monochrome) affordably, though slowly, for systems running Windows 3.x and 95.

oasting inexpensive, high-

I tested the MD-4000 in a Windows environment. The MD-4000 resembles the MD-2010, but within it is a 24-bit, 600-dpi, TWAIN-compatible, sheet-feed color scanner, which makes it an affordable one-package solution for image acquisition and printing. Alps also offers a Mac version.

With four snap-in ribbon cartridges, the MD-4000 supports hands-off CMYK printing. The printer determines the position of each cartridge. If a needed color isn't loaded, the printer prompts you for it. A \$6.60 ribbon produces about 35 to 40 pages at 100 percent coverage. Alps also offers 20-page metallic ribbons (gold, cyan, magenta, and silver) for \$8.99 each.

Alps claims that the MD-4000 doesn't require special paper, and my testing bore this out. I printed full-color images on

TECH FOCUS

Micro What?

The Alps "Micro Dry" process applies dry resin-based inks to paper with a 240-element thermal-transfer head. Like wax-thermal-transfer printers, the MD-4000 melts small dots from an ink-coated ribbon, one pass per color. Unlike wax transfer, resin-thermal transfer doesn't require special paper, and the output doesn't look waxy.



The MD-4000 also has a 600-dpi color scanning head on its printing carriage. Printing and scanning share the same paper path.

copy paper, postcards, iron-on T-shirt transfers, transparencies, and photographs, as well as other coated papers, with good to excellent results. The MD-4000's multipass print engine shows minor banding only on large expanses of CMY-composite black. The printer's default color-matching produced acceptable-looking prints, and the Windows driver gives you ample opportunity to fine-tune the output.

The MD-4000³ s pluses are quality and affordability; speed is the minus. It took 8 minutes to print an A4-size color image at 600 dpi. Reducing image size or density accelerates the printing process proportionally. Text prints at a page per minute. Mechanically, the printer is less than rugged. A bevy of pull-out, flipdown, and sliding trays, drawers, and compartments invite accidents. I also found the feeder tray somewhat finicky.

To scan a document, you must place it in a plastic envelope—a 4- by 6-inch

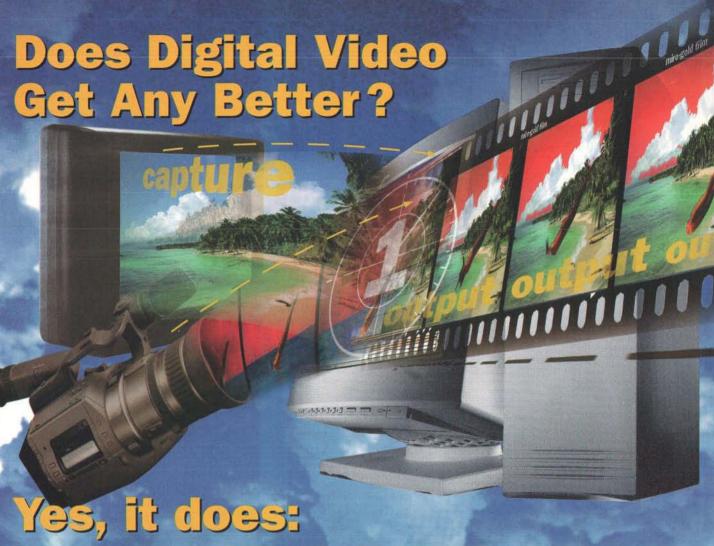
unit for small documents and photos or an 8½- by 14-inch unit for larger media. The Alps Copy Studio software provides bare-bones service. For anything beyond color copying, you'll want to scan from your own TWAIN-compatible image edi-

RATINGS					
TECHNOLOGY	*	*	*	*	888
IMPLEMENTATION	*	*	*		
PERFORMANCE	*	*			

tor. Alps includes Adobe's consumer-oriented PhotoDeluxe with the MD-4000.

The MD-4000 printer isn't likely to find a home in a high-production photo studio. But for the small office or home, the attraction is clear: durable, high-quality color printing and high-resolution scanning at an affordable price.

Robert L. Hummel is an electrical engineer, programmer, and consultant. You can reach him at rhummel@monad.net.



res, it does: miroVIDEO DC30.

Professional studio quality video for your PC,

because

miroVIDEO DC30 PCI bus mastering provides the fastest data rates (up to 6 MB/sec), the highest resolution (4:2:2 YUV TrueColor) with the best image quality (3.5:1 compression). CD quality audio with perfect lip synchronization,

because

miroVIDEO DC30 integrates audio with video on a single board so you don't miss a beat. Real-time video-overlay,

because

miroVIDEO DC30 displays full-motion video directly on the PC monitor at all times. True WYSIWYG video during capture, edit and print-to-tape. disk usage,

Optimal hard

because

miroVIDEO DC30 has fully adjustable video resolution and compression settings to provide the best video quality in the space available. High-speed video editing.

because

miroVIDEO DC30 has specialized hardware and world-class drivers to accelerate video editing software—up to 10 times faster with Adobe Premiere software during "make movie" and "preview edit" mode.

Fall '96

M1637 Sanda Convention Center Las Venas

Circle 192 on Inquiry Card (RESELLERS: 193).

Professional digital video and audio editing system PCI bus mastering technology, for the

- fastest data rates up to 6 MByte/sec.
- ► On-board CD audio
- ► Ready for Windows 95
- ► Input and output for S-VHS, Hi8, VHS, Video8 ► All standards: NTSC, PAL, Secam at CCIR 601
- All standards: NTSC, PAL, Secam at CCIR 60: pixel format and square pixels



miroVIDEO DC30





The HEART of an Artist"

Vivid colors. Ergonomic design. Performance and features to include the visionary in you.

Princeton Graphic Systems® monitors have always had a solid reputation for pushing performance barriers far beyond industry standards. This tradition was proven with the highly respected Ultra 15 which won *PC World*'s Best Buy Award a remarkable three times in a row. The 135MHz/82KHz Ultra 17+ further redefined the industry with its award-winning, high refresh rate performance and ultra-low

winning, high refresh rate performance and ultra-low price. Now, our **E**xtra**O**rdinary new models surpass even our own stellar benchmarks.

Case in point, the EO75. With its super-high 95KHz horizontal frequency, 200MHz video bandwidth and an ultra-fine 0.26mm dot pitch, this 17" (15.8" viewable) monitor delivers a bold, flicker-free resolution of 1600 x 1200 @ 75Hz. That's rock-solid performance. Furthermore, our engineers added Enhanced Imaging Circuitry for a sharper focus without the moiré problems so common to other 0.26mm monitors. That's a difference you can see!

Princeton's next generation of EO monitors incorporates PreVuSM controls and ColorightSM technology perfect for intense, graphical applications. In addition, Princeton offers an ExtraOrdinary, full three year "Bucket to Bezel" limited warranty*.

The EO Series is already available at your nearby dealer. See it today. Their performance will win your heart. Their price will ease your soul.

"The SOUL of an Accountant"

\$722 ESP

Princeton Graphic Systems • 2801 S. Yale St., Ste. 110 • Santa Ana, CA 92704 • Tel. 800/747-6249 or 714/751-8405 • Fax 714/751-5736 • Fax-On-Demand 714/751-0168 • Web Site: www.prgr.com

© 19⁵6 Princeton Graphic Systems. All rights reserved. All trademarks are the properties of their respective owners. As an Energy StarSM Partner, Princeton Graphic Systems has determined that these products meet Energy StarSM Guidelines for energy efficiency. Prices and specifications are subject to change without notice. *PreVuSM and ColorightSM are not available on the EO40. Full three-year limited warranty is offered on the following models: EO40, EO50, EO17, EO70 and EO75.



800-747-6249 ext. 165



With its latest GroupWise release, Novell goes head-to-head with groupware giants Lotus and Microsoft. By Steve Gillmor

GroupWise Sends a Message

the release of Novell's Group-Wise 5 (hereinafter GW5), which adds significant document management tools to an already feature-laden messaging product. The new version also has state-of-the-art NetWare Directory Service (NDS), TCP/IP client/server technology, OLE automation, shared folders, and an enhanced interface.

hoosing the right groupware

product is harder now with

We installed the GW5 beta on a Net-Ware 4.1 server, using NetWare Administrator 4.1.1. An included two-user version of NetWare 4.x gives access to NDS tools. Initially, GW5 runs only on Windows NT Server. Setup went smoothly. The GroupWise Setup Adviser walks you through extending the NDS tree; defining domain, post office, and agent names, locations, and contexts; and adding current users or new ones.

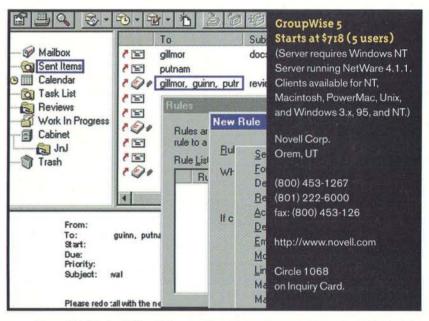
The GW5 client adopts a three-pane interface, like cc:Mail, Lotus Notes, and Microsoft Exchange. The left window displays the folder list. You can organize multiple item types by subject or by project in folders within cabinets, and sharing folders is easy.

GW5 leads the pack in document management. Novell has integrated much of its Soft Solutions product, including doc-

Still to Come

The initial release of GroupWise 5 does not include everything we'd hoped for. Here are a few important omissions:

- Novell's GroupWise WebAccess supports busy searches and virtually all of GroupWise's client functions via the Internet, but this isn't bundled into GW5.
- You can't create custom icons for specific URLs in the mailbox.
- · Unix and OS/2 versions are in the works.
- Promised work-flow tools won't ship until a later, interim release.



Novell's GroupWise lets you use drop-down menus to select event types, condition filters, and actions.

ument check-in, check-out, versioning, sharing control, version-level security, and an activity log. Documents are stored in libraries, and mailboxes display only references to documents.

GW5 adds client/server connectivity while maintaining its drive-mapped access to the post office to ease migration and use existing hardware. Group Wise's proxy capability lets users access other mailboxes in different post offices.

With GW5 you can convert items from one type to another—for example, mail messages to calendar appointments. You can track message status by right-clicking a mailbox item and viewing its properties. You can also see incoming and outbound messages in a threaded view. You can create a rule to move items into folders, and you can define trigger events that let rules execute on a server—when you're away, for instance.

GroupWise offers a complete toolkit for messaging, calendaring, scheduling, and managing documents. It also gives you tools for single-point NDS-based

RATINGS						
TECHNOLOGY	*	*	*	*	*	
IMPLEMENTATION	*	*	*	*		

administration. The package represents a tremendous value for existing NetWare shops. Its ease of use and configurability compete favorably with Exchange, but its Web integration lags behind Notes' Domino technology. And with Windows NT gaining fast on NetWare, the network administrator must think twice before making the leap to GroupWise.

Steve Gillmor, of Southern Digital, has extensive experience with groupware applications. You can reach him at sgillmor@aol.com.



MarketScape's WebCD packages Web content for off-line use and automates CD-ROM mastering. By Jon Udell

Hybrid Web/CD-ROM: Do It Yourself

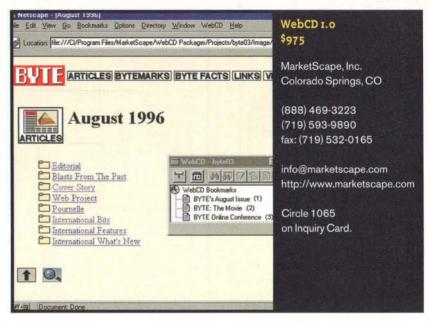
hy bother with CD-ROMs in the Web era? There are lots of reasons. Try hosting an 8-minute video on your Web site. Try asking your sales force to demonstrate your site to non-Web-connected clients. Try using your site's content on an airplane. You can solve all these problems with MarketScape's WebCD.

CD-ROMs that venture on-line to augment static content with live updates have been around for a decade. MarketScape calls it the "big CD, small Web" model. WebCD heralds a new era—big Web, small CD. It acknowledges the primacy of the Web. It delivers a native Webbrowsing experience and adds value to that experience by facilitating the effective use of high-bandwidth content, offline access to all packaged content, seamless Web integration when on-line, and content aggregation across multiple sites.

To build a site image, you run WebCD Packager, a Windows 95 application that integrates a Web crawler, a browser, and a CD-ROM-mastering utility. Point it at your Web server—or even several of your servers, or any servers anywhere (be careful!)—and scoop up the content you need. As you construct a package, you can browse it live—no waiting until the build finishes before you can view it.

To distribute the image, you deliver it—on a CD Recordable (CD-R) disc, tape, or conceivably by way of FTP—to a mastering shop. The image contains all your Hypertext Markup Language (HTML), GIF, Audio Video Interleave (AVI), and other files, mapped to the eight-dot-three filename convention required by ISO-9660 and optimized for the peculiar access behavior of CD-ROM drives.

The image also contains a setup program that installs WebCD Viewer. It's a wrapper that will find and integrate with Netscape Navigator or Microsoft Inter-



WebCD lets you seamlessly integrate live Web pages with static pages and high-bandwidth data types such as video.

net Explorer, adding to either browser a floating window that controls special WebCD search and bookmark functions. Mac and Unix users miss out on WebCD Viewer. However, they can point their browsers directly at the data.

Itested WebCD Packager on The BYTE Site. The image I built (see the photo) combines articles from our document server with messages from our conference server. When you aggregate content across multiple Web servers (or sites), where's the home page? You can choose an existing one or make a new one, but either way, you'll want WebCD Viewer's bookmarks to call out landmark pages.

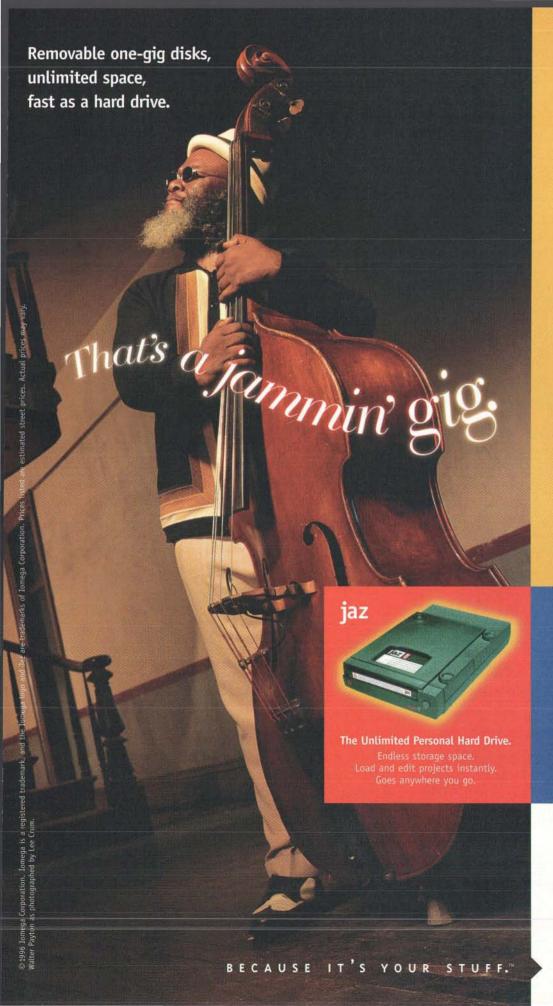
I discovered a few glitches. Although it supports proxy servers, WebCD could not tunnel through our multiple-proxy setup. Because it interleaves uniformresource-locator (URL) discovery and retrieval, I found it tricky to map out our whole site before choosing what to package. Also, when I ran my first build, some links resolved on-line rather than locally. I'd have liked a verification tool

RATING	S	0	d	1	
TECHNOLOGY	*	*	*	*	*
IMPLEMENTATION	*	*	*	*	

to ensure that all referenced pages were included in the package. You wouldn't want to find on-line dependencies after you mastered your CD-ROM.

Its minor immaturities aside, WebCD is an outstanding tool that I recommend highly. There's no easier or better way for marketers to transform a company's Web site into a distributable, stand-alone, high-impact presentation.

Jon Udell (judell@bix.com) is BYTE's executive editor for new media.



For the nearest dealer, call: 888-2-IOMEGA, ext. j22 Or see us at: www.iomega.com



The Jaz" drive is you, man. It's fast, it holds tons of stuff, and it's personal. You won't find an easier or cooler way to upgrade your hard drive. Just connect it to your PC or Mac and you're jammin': files, pictures, graphics, video, CAD stuff, whatever. And with its dark green color, hey, the cat's got style.

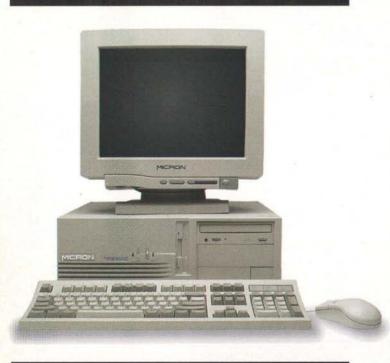


1GB disks for as low as \$99.95.

Compact one-gigabyte cartridges. Great for graphics, sound, and video Portable files. Fast, easy backup.

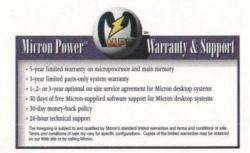


TAKE THE DAY OFF.



Your business decisions just got easier.

Now there's a PC that's flexible and sensibly priced for your office or department—the ClientPro™ system from Micron Electronics. Designed for long life and reliable, affordable performance, this new PC offers years of productive and adaptable computing without costly system upgrades. Now we are matching the power and reliability of the ClientPro PC with powerful system software by introducing the new 32-bit operating system everyone is talking about—Microsoft® Windows NT® Workstation. With the ClientPro PC, you get a system custom-configured to fit your office needs, network-ready with Windows NT Workstation and backed by our industry-leading Micron Power™ warranty.





- Intel 120MHz Pentium® processor
- 256KB pipeline burst cache, flash BIOS 3Com® 3C509 Combo network adapter

- 3Com® 3C509 Combo network adapter
 3.5" floppy drive
 PCI 64-bit graphics accelerator, 2MB EDO RAM
 Tool-free minitower or desktop
 Microsoft® Mouse, 104-key keyboard
 MS-DOS® 6.22/Windows® for Workgroups 3.11
 Microsoft Works preinstalled
- - 16MB EDO RAM 1.2GB EIDE hard drive
 - 14" Micron 14FGx, .28dp (12.9" display)

Bus, lease \$51/mo.

- 16MB EDO RAM 2.1GB EIDE hard drive
- 15" Micron 15FGx, .28dp (13.7" display)

Bus. lease \$58/mo.

With Intel 133MHz Pentium processor......add \$50

- Intel 180MHz Pentium® Pro processor
- 256KB internal burst cache, flash BIOS 3Com 3C509 Combo network adapter
- Com 3C509 Combo network adapter
 PCI 64-bit graphics accelerator, 2MB EDO RAM
 3.5" floppy drive
 16MB EDO RAM
 1.2GB EIDE hard drive
 14" Micron 14FGx, 28dp (12.9" display)
 Microsoft Works preinstalled
 Tool-free ministower or desktop

- Tool-free minitower or desktop
 Microsoft Mouse, 104-key keyboard
 Microsoft Windows NT® Workstation
- 5-year/3-year Micron Power warranty

Bus. lease 68/mo.







Tollfree from Canada 800-708-1758



95-800-708-1755



Tollfree from Puerto Rico 800-708-1756

208-893-8970



208-893-7393

900 E. Karcher Road, Nampa, ID 83687 • Mon-Fri 6am-10pm Sat 7am-5pm (MT) International Sales Hours: Mon-Fri 6am-7pm (MT) 208-893-3434 • Fax 208-893-3424 • Purchase Order Fax 208-893-8992 • Technical Support Available 24 Hours / 7 Days Technical Support E-mail: techsupport.meic@micron.com

©1996 Micron Electronics, Inc. All rights reserved. Micron Electronics is not responsible for omissions and/or errors in typography or photography. All purchases are subject to availability. Prices and specifications may be changed without notice; prices do not include shipping and handling. 30-day money-back policy does not include return freight and original shipping/famdling charges, applies only to Micron brand products and begins from date of shipment lasles are subject to Micron Electronics' current terms and conditions of sale. Lease prices based on 36-month lease. Intel, Intel Inside and Pontium are registered trademarks of the Intel Corporation. Microsoft, Windows, the Windows logo and Windows NT are registered trademarks of Microsoft Corporation. All other service marks, trademarks and registered trademarks are property of their respective companies.

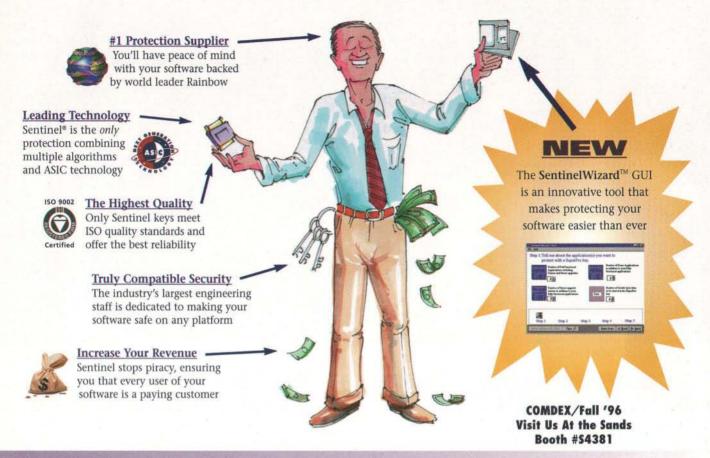
BYTE-CLPR-9611

Circle 174 on Inquiry Card.

ELECTRONICS, INC.

p://www.mei.micron.com

A developer's dream come true...



The world's #1 software protection is now the easiest to implement!

You've always dreamed of superior software protection that was simple to integrate into your entire product line. The new SentinelWizard makes your dream a reality.

Just tell the SentinelWizard how you want to sell your products. It then automatically configures your Sentinel keys and generates the pseudo code necessary to complete the protection process. Call the Rainbow office or distributor nearest you to order your Sentinel Developer's Kit, featuring the SentinelWizard.



Ask us about SentinelLM™ - the new software-based network license manager

Visit our web site www.rnbo.com SENTINEL Software Protection

RAINBOW

HEADQUARTERS: 50 Technology Drive, Irvine, CA 92618 ■ Tel: (714) 450-7300 ■ Fax: (714) 450-7450 ASIA/LATIN AMERICA: (714) 450-7300 ■ FRANCE: (33) 1 41 43 29 00 ■ GERMANY: (49) 89 32 17 98 0 ■ U.K.: (44) 1932 579200 ©1996 Rainbow Technologies, inc. Sentinel, SentinelLM and SentinelWizard are trademarks of Rainbow Technologies. All other names are property of their respective owners.

ALGERIA: AFAK (21.3) 41 85 61 ARGENTINA: Agri-Aid, S.A. (54) 1 8030536 AUSTRALIA: (JOADPLAN (61) 3 9690 0455 BELGIUM/LUXEMBURG: E25 (32) 92.21 11.17 BRAZIL: MPS Sistemas Ltda, (55) 11 574 8686 BULGARIA: KSIMETRO (35) 9279 1478 CHINA (East): Shanghai Putdong Software Park. Electronics Company (86) 21 6403 1966 CHINA (North): CS&S (86) 10 6217 7722 X2404 COLOMBIA: Construdata (57) 1 622 6011

CZECH REPUBLIC 2 3103 652 EGYPT: ZEDAN-ADS (202) 248 8994 GREECE: Byte Computer S.A. (301) 924 17.28 GUATEMALA: Soft Corporation (502) 2 304006 HONG KOMG: Alfalink Tech. Co. (852) 2333 0626 HUNGARY: Polyware Kft. (36) 76 481 236 HUNGARY: Polyware Kft. (36) 76 481 236 HUDIA: ANC Engineering Co. (91) 11 4615680 HUDIASIA PE. Promprade InfoSan (62) 21 375 166 IRAN: GAM Electronics (98) 21 87 44 001 ITALY: BPI IBEXSA SPA (39) 23 31 00535 ITALY: Siosistermi (39) 30 24 4.11
JAPAN: Giken Shoji Co., ttd. (81) 52 972 6544
JORDAN: COG Engineering (96) 26 863 861
KOREA: Genesis Technologies (82) 2 578 3528
LEBANON: National Group Cors. (961) 1 494317
MALAYSIA: Eastern Systems Design
(M) Scin Bhd (60) 3 24.1 11.88
MEXICO: Impex Comp., S.A. de C. V. (52) 66 210 291
MOROCCO: Futur & Soft (212) 2 40 03 97

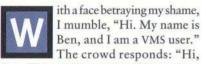
NETHERLANDS: IntroCom (31) 74 2430 105 NEW ZEALAND, SOftware Images (64) 09 378 9790 PERU: OpenSoft (51) 1 224 2125 PHILIPPINES Mannasoft Technology Corporation (63) 2 813 4162 POLAND: HITEX 5p. 2 o.o. (48) 22 41 97 51 PORTUGAL: COMELTA (351) 1 941 65 07 RUSSIA: Multisoft Int (7 095) 186 35 84 SAUDI ARABIA: EZDAN (966) 2 665 1994 SCANDINAVIA: Perico AS (47) 2249 1500

SINGAPORE: Systems Design PTE LTD (65) 747 2266
SOUTH AFRICA: SOFTSECURE (27) 11 477 6053
SPAIN: MECCCO (34) 3 422 77700
SWITZERLAND: IBV AG (41) 1 745 92 92
SWITZERLAND: Safe Compad 5A, (41) 2 47 595
SWITZERLAND: Safe Compad 5A, (41) 2 47 936
TAIWAN: Evershine Tech. (886) 2 8208925
THAILAND: BCS Int'l (66) 2 319 4451
TURISA: Soft Informatique Tech (216) 17 19 486
TURIKEY: BIMEKS, Ltd. (90) 216 348 3508
VENEZUELA: HRT-IM Oser (58) 2 261 4282



Better reasons than tradition explain why Digital's VMS operating system continues to survive. By Ben Smith

VMS: Alive and Well



Ben. We're VMS users, too!" But using a 20-year-old OS called VMS—which unofficially stands for Virtual Memory operating System—doesn't mean you have a disease, or even a temporary condition.

Besides its longevity and proliferation, due in great part to its robustness and sophisticated management design, VMS is adept at handling mission-critical jobs, and its clustering capabilities make it well-suited for multiprocessing. The OS isn't without flaws, which become more apparent because of its age. But Unix, which is even older, is growing in popularity, whereas VMS is just holding its own. Is VMS at the end of its life cycle?

Who Uses VMS, Anyway?

The VAX computer and VMS have been inseparable since birth. In fact, the VAX is one of the earliest designs in which the software engineers played a major role in the hardware design: They determined what structures and services should be implemented in microcode. Now, with the VAX being supplanted by Alpha VMS servers, VMS survives beyond its original architecture despite the close hardware ties.

VAXes have been applied to every kind of computing, so VMS has been used by every kind of user, from scientists running supercomputing applications to office workers doing word processing. But the days of broad-spectrum computing are past. Personal computers and much simpler LANs have replaced VAXes and terminal servers for low-end office computing. What work can't be handled by desktop computers can be done inexpensively on Unix machines and, despite their immaturity, Windows NT servers. Still, VMS can be found handling the crit-

ical, the fault-tolerant, and the secure computing jobs such as bank and stock market transaction processing, record keeping, and billing systems. A hiccup in any of these applications could cost

A VMS Time Line

April 1975: DEC's Gordon Bell writes memo that starts formal work on VAX/VMS.

April 1978: First VAX shipped, with a preliminary version of VMS.

August 1978: VMS 1.0 ships.

April 1980: VMS 2.0, VAX/750 (first new processor) added to DEC product line.

April 1982: VMS 3.0, VAX/730 rolled out. Ethernet connectivity added.

September 1984: VMS 4.0 and VAXcluster introduced. Many new VAX models introduced.

September 1988: VMS 5.0, the VAX 6000, and symmetric multiprocessor VAXes introduced.

November 1992: VMS 1.0 for the Alpha processor released.

July 1993: VMS 6.0 released. The major features are support for very large VAXes and a C2/B1 government security rating.

January 1996: VMS 7.0 released. Kernel-level support for DECthreads and 64-bit memory management supported on Alpha.

millions of dollars in a flash, or even put lives in jeopardy.

Another important VMS feature is clusters. The basic concept is: If performance isn't adequate, add another server; they all appear as one.

The engineering and research communities have a huge investment in VMS applications. These are the millions of lines of FORTRAN code that also fall into the category of legacy systems. These hoary applications work perfectly well in the VMS environment, and they continue to gain in performance whenever Digital ships a newer, faster, VMS server.

Another reason for the OS's continuing popularity is a feature that all VMS applications exploit: VMS programs can share the same data types, system resources, and process control. Developers can thus seamlessly build a monolithic application in which each individual part is crafted in the language best-suited for its function. For example, an application's general business logic might be coded in COBOL, its bit-manipulation aspects written in C, and its sophisticated numeric operations and utilities composed in FORTRAN.

VMS vs. Unix

VMS, along with its hardware counterpart, the VAX, was over a year in design, not counting the six months of discussions that took place before Gordon Bell (then head of R&D at Digital) wrote a memo, in April of '75, committing to its development. From the very beginning, VMS was built for demanding commercial applications. The VMS/VAX design team tried to anticipate all the levels and details that any commercial operation might need, and to implement them at as low a level as practical. High on the list of VMS features has been its consistency, its rich set of management features, and its security (C2/B1 rating from the U.S. government). Most important, VMS was the VAX's native operating system. Even today Unix, which is VMS's closest competitor, is considerably weaker in all these areas. Conversely, VMS's file system still lacks the ability to handle more than eight levels of subdirectories.

Unix is the quintessential example of ad hoc OS development. Unix grew out

In Case of Emergency, Use Duplicate Clusters

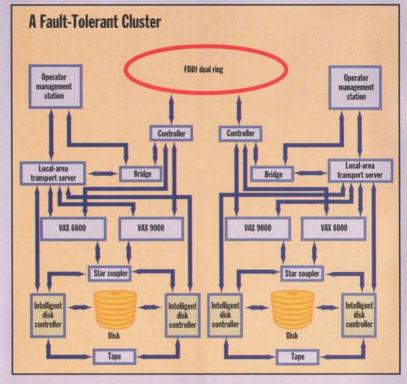
pigital implements multiprocessor computing over the entire spectrum of configurations: from tightly coupled computers that share memory and whose processes must be tightly synchronized, to the very loose asynchronous model of networked heterogeneous computers that share tasks through remote procedure calls (RPCs). The VMScluster lies between these two extremes.

VMS cluster implementations share resources between processors in such a way that the processors and the resources appear as a single system to the user. The connections between a cluster's elements can be through just about any method; the loosest is a simple Ethernet connection. These connections are made through redundant one-way cables with duplicate "send" and "receive" ports.

For disaster tolerance, portions of the cluster "mirror" the activity of the other portion, as shown in the figure at right. That is, the system takes all the processing and storage that lives on one part of the cluster and duplicates it in another part of the cluster. One side is designated as the primary segment of the cluster until it fails, at which time the other section becomes the primary.

By placing parts of a cluster several miles from the other and having the processing and storage mirrored between the sites, disasters such as a power failure or fire at one site don't affect the others. When the systems are connected by high-bandwidth

fiber-optic lines, processing continues uninterrupted. This kind of fault-tolerant computing is what stock exchanges, electronic funds transfer centers, and military systems require. Additionally, VMS is laudably secure in contrast to the majority of Unix systems.



Smart disk controllers make devices they manage available to all processors on the net, thus resembling a unified system.

of a solution to running a compute-intensive simulation program on a computer that had been all but abandoned (ironically, a DEC PDP-7). Unix has grown as need be. Great leaps in design have been the result of some special application, research project, or academic program. Unix didn't actually become a commercial product (from Interactive Systems Corporation) until 1977, the same year that VAX/VMS was announced at a DEC stockholders' meeting.

While the VMS OS was integral to the VAX and hadn't (until the DEC Alpha) run on anything but VAX computers, Unix has been uniquely portable. Because of its humble roots and minimalist hardware requirements, Unix was quickly ported to all platforms, including the VAX. Despite the system's haphazard beginnings, many Unix features have become models for implementing simi-

lar services on other OSes, including Unix's simple file I/O, which was extended to devices and interprocess communications (through sockets); a configurable hierarchical file system; and more than one way for a user to interface with the OS (different command interpreters, or "shells").

Reports of My Death Are Greatly Exaggerated

An OS has reached its terminus when it's no longer breathing with new development. VMS is still alive. And it's drawing new energy from another OS: NT. The connection here is DEC's NT Affinity product and the concept of using VMS servers to do the high-end computing for NT servers and workstations. To support this capability, VMS has incorporated many of NT's data structures and design elements. There is a life-supporting trans-

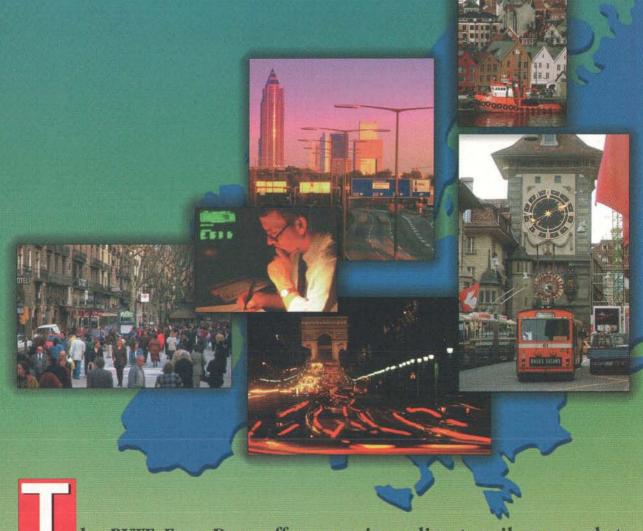
fusion going on between VMS and NT.

The VMS development group is very much alive and well. Some of the original developers are still there, turning out new releases. The truth is, VMS does just fine for its long-term customers who are running COBOL and FORTRAN applications, as well as for customers writing applications in C/C++, using RDB or Oracle databases and doing distributed transaction processing. Both of these types of users are going to be around for a long, long time.

VMS still serves as a reliable tool for getting the job done, particularly in mission-critical situations. There is no shame in being a VMS user.

Ben Smith is an independent contract programmer specializing in Unix and Perl. He used to be a BYTE technical editor. You can reach him at ben@ronin.com.

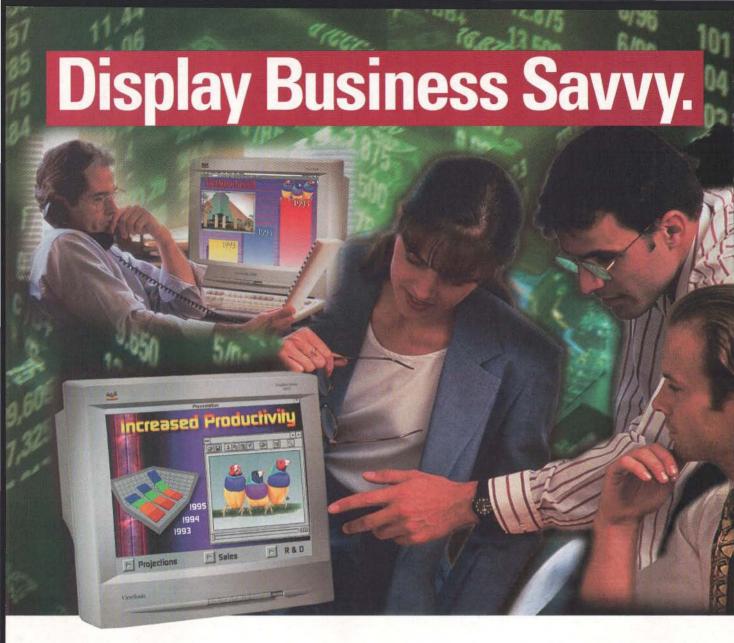
BYTE's Pan-European Postcard Deck Targets Influential European Technology Experts



he BYTE Euro-Deck offers a unique direct mail approach to increasing sales in the \$114 billion European computer market. Reach 50,000 BYTE subscribers for under 4¢ per reader!

Circulation of the BYTE EURO-DECK is targeted to computer experts in over 20 countries in Western Europe. Take full advantage of the benefits BYTE provides with this affordable,

direct channel to Europe. For information on the next BYTE EURO-DECK, call Mark Stone at 603/924-2533, fax him at 603/924-2683 or use E-mail: 104124.1255@compuserve.com.



Whether your business relies on basic spreadsheets or the most advanced multimedia applications, ViewSonic® has the perfect Graphics Series monitor for YOU! In fact, our Graphics Series offers NINE different monitors, ranging from 15" through 21" (various viewables) for both PC and Mac® systems. Each provides a unique combination of performance, features, value and screen size to meet your specific needs.

Graphics Series Monitors

Our Graphics Series offer features like OnView® controls for easy on-screen adjustments, ViewMatch® to match screen color to printer output, and overscan capabilities which provides use of the entire screen. And *Plug & *Play +* for easy installation with Windows® 95.

For multimedia, personnel training and internet applications, the Graphics Series $PerfectSound^m$ 15GA and 17GA multimedia monitors are the ideal choice.

Product	CRT Size/ Viewable	Dot Pitch Aperture Grille*	Max. NI Resolution	OnView* Controls	TCO Certified	MSRP
ViewSonic 15GS	15"/14.0"	0.28mm	1,280 x 1,024	Yes	Yes	\$449
ViewSonic 15GA	15"/14.0"	0.27mm	1,280 x 1,024	Yes	Yes	\$499
ViewSonic 17GS	17"/16.0"	0.27mm	1,280 x 1,024	Yes	Yes	\$699
ViewSonic 17GA	17"/16.0"	0.27mm	1,280 x 1,024	Yes	Yes	\$799
ViewSonic GT770	17"/15.9"	0.25mm*	1,280 x 1,024	Yes		\$795
ViewSonic 20G	20"/18.4"	0.28mm	1,600 x 1,280		Yes	\$1,299
ViewSonic GT800	20"/19.1"	0.30mm*	1,600 x 1,280	Yes		\$1,495
ViewSonic G810	21"/20.0"	0.25mm	1,600 x 1,280	Yes		\$1,745

Alf monitors are EPA Energy Star^{ia} and MPR-II certified. *Aperture Grille Free VMA-1 Mac cable adapter availab

With high fidelity speakers integrated into the bezel for directed stereo sound, a built-in microphone*, headphone jack, as well as mute and volume controls, these *award-wirming* monitors offer a unique experience in sight <u>and</u> sound.

The ultimate in high performance monitors, the ViewSonic GT770 and GT800 blend aperture grille mask technology and the vertically flat SonicTron™ screen to produce the sharpest, most brilliant colors from center to corner. The high contrast images are the richest and brightest available today.

Our monitors are backed by a limited 3-year warranty on CRT, parts and labor... the best in the business. Plus your company can take advantage of our special 48-hour Express Exchange^w Service option.

ViewSonic®

At ViewSonic, we make more than just good business monitors. We make good business sense.

Phone: (800) 888-8583 or (909) 869-7976; Agent Code 1266 Internet: http://www.viewsonic.com

Optional microphone adapter may be required with certain Macintosh systems.

Prices and specifications subject to change without notice, Corporate names and trademarks stated herein are the encourse of their respective companies. St. 1998 Vises Sonic Corporation, All 'either respective of their respective of their specific companies. St. 1998 Vises Sonic Corporation, All 'either respective companies. St. 1998 Vises Sonic Corporation, All 'either respective companies.

















Sun's revised NFS could overcome HTTP's limitations in handling large amounts of Web data. By Bob Friesenhahn

A File System for the Web

he popularity of the Web has skyrocketed in the past few years. Few technical challenges have impeded its expansion. However, it is beginning to show severe growing pains. Popular Web sites now use networks of multiple highperformance computers to sustain the heavy load when serving data via HTTP.

The intranet is now beginning to rival the Internet's growth. Corporate users expect to manipulate Web data in the same way that they deal with data in their other productivity applications. Unfortunately, poor data-manipulation capabilities are the Achilles' heel of existing Web technologies.

The Web is based on Hypertext Markup Language (HTML) and the simple HTTP. While it's simple to implement and understand, HTTP is an expensive protocol in terms of connection overhead and data transfer. Each object you transfer via HTTP requires a new TCP connection. (See "The Backbone of the Web," October BYTE, for details.) Furthermore, you must transfer the entire object at one time. Each HTML page can contain references to other objects (e.g., graphics images) that you must download to build the entire page. This requires additional TCP connections.

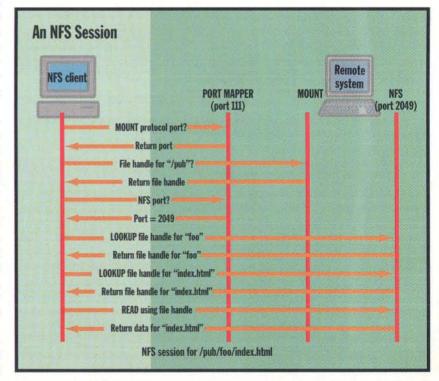
Web browsers such as Netscape's Navigator have adopted a threaded model that allows multiple HTTP accesses to be concurrent per HTML page. While threading helps avoid TCP-connection latencies (causing pages to load faster), it increases the load seen by the server.

What we need are more efficient Web data-access technologies that let users selectively access, manipulate, and update data as they have become accustomed to. Sun Microsystems believes it has a technology in its inventory that can provide the solution with a little brushing up. The basic technology is NFS, and

the Web-enhanced version is called WebNFS.

NFS in a Nutshell

NFS implements a virtual network file system that maps remote disks so that they appear local to a client computer on the network. NFS is a mature product that Sun introduced commercially in 1986. It RFC 1014. Client and server versions of NFS are available for all major OSes. Development of NFS is relatively easy, because the source codes to XDR, RPC, and NFS are available in the public domain. Alternately, you can license NFS technology from Sun as part of its ONC+ platform, which most Unix system vendors license.



NFS requires many data transfers to establish access to a specific remote file.

rose to industry-standard status in 1989 with the publication of RFC 1094, covering NFS 2. In 1995, there was the publication of RFC 1813, which covers NFS 3.

NFS is based on Sun remote procedure call (RPC), RFC 1057, which is in turn based on data formats established by External Data Representation (XDR),

Sun considers any Web use of NFS—whether it's NFS 2, NFS 3, or NFS with WebNFS enhancements—to be a form of WebNFS. This can be extremely disconcerting to users, given that no specific form of the protocol can be labeled as WebNFS. In this article, I refer only to Web-enhanced versions (described

below) of NFS as WebNFS, rather than using Sun's broader scope.

The Evolution of NFS

If NFS is so great, how come we have not seen it used on the Internet? NFS is an efficient protocol that's optimized for LANs. As such, it originally relied on UDP, which provides no flow-control mechanisms or error recovery, other than for timeouts. Because of this, NFS has proven to be largely unusable over the Internet.

With the advent of NFS 3, TCP became the preferred transport protocol. TCP offers flow control, reliable transfer, and ordering characteristics that UDP lacks. With Sun's recent announcement of WebNFS, many of NFS's drawbacks over high-latency networks have now been eliminated.

Unaltered NFS is a terrible protocol for use over high-latency networks, as shown in the figure "An NFS Session." NFS's design was intended to be pure in that few assumptions were made regarding the OS's characteristics, such as path-name separators or even port addresses. Similar to other protocols based on Sun RPC, a port-mapper process maps the RPC protocol types to specific port addresses.

NFS depends on two RPC protocols: MOUNT and NFS. MOUNT gets a handle to the top, or start, of a directory tree. Once MOUNT accomplishes this, the client has "mounted" the server and uses this handle through the remainder of the session. Unfortunately, all this port mapping takes quite a bit of time over slow networks.

A more significant problem than port mapping is how NFS works with files. Rather than access files via their full paths, NFS iterates through the directory elements, retrieving file handles for each element. NFS then uses the final file handle to read the file.

To improve its performance over highlatency networks, NFS needs to eliminate port mapping, mounting, and path-name recursion overheads. To accomplish this, WebNFS makes three assumptions: The NFS default port is 2049, a directory can be exported as "public" with a known handle (zero or null length), and pathname delimiters are similar to an HTTP uniform resource locator (URL). That is, they use a forward slash to separate path elements, which lets full file paths be specified.

WebNFS thus introduces a new type of

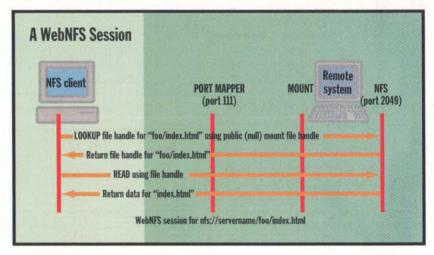
URL, the *nfs URL*. Nfs URLs are specified via the format nfs://server:port/path, which is immediately familiar to Web users because the format is similar to that used by HTTP. As just mentioned, Web-NFS uses the default NFS port of 2049, unless the URL specifies one.

The steps the modified protocol takes are illustrated in the figure "A WebNFS Session." These steps reduce the number of RPC packet transmissions to retrieve a relatively short path name from 12 to four. Furthermore, with traditional NFS, retrieving extra path elements increases

vide in the future) cannot be supported directly by WebNFS.

For example, WebNFS does not support the Multipurpose Internet Mail Extensions (MIME) Content-Type information, a feature that HTTP supports. Thus, data that's obtained via WebNFS must be identified locally by some means (usually a file extension) rather than being identified by the server (which could have more accurate information).

WebNFS has another significant limitation: It is impossible to support server applications without radical modifica-



Smart defaults and an improved file mechanism reduce access to remote files to a fixed number of transfers.

the number of packets sent by two per element. With WebNFS, the required number of packets remains constant.

Presuming packet latencies of 250 milliseconds, the overhead to retrieve the first file on a server is reduced from a minimum of 3 seconds to 1 second (not including TCP-connect time). NFS RPC requests are inherently threaded in that you can send them in any meaningful order and back-to-back. This tremendously enhances throughput and decreases the effects of network latency, because responses stream back to the client as requests are serviced.

WebNFS Limits

While use of WebNFS provides significant performance and usability benefits, it has inherent limitations. They are related to the fact that NFS implements a file system. A network file system implements the semantics of a file system on a local disk drive. As a result, many features that HTTP provides today (or may pro-

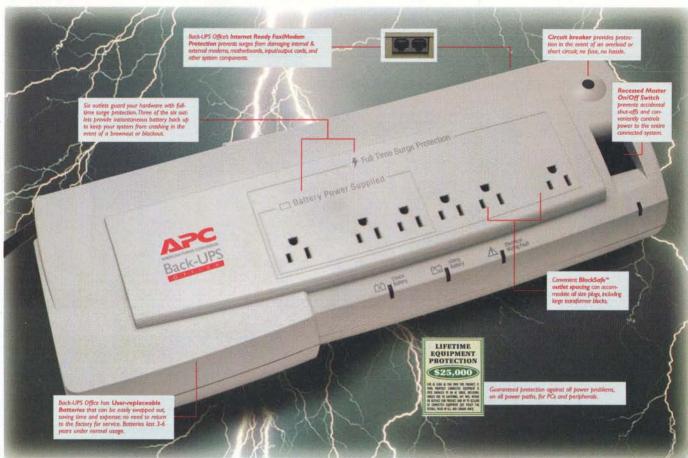
tions to the NFS server. You might overcome this limitation by simply using HTTP where NFS is not appropriate.

Will you ever see WebNFS in a Web browser near you? There are still many unanswered questions regarding how WebNFS would be made available in a browser, and even whether any major browsers will support it. WebNFS has the technical prowess to become a major Web technology. At the same time, we have seen how difficult it is to predict which technology will succeed. We can only wait and see how the story unfolds.

If you would like to learn more about WebNFS, Sun has made the technical details available (including an excellent white paper by Brent Callaghan of Sun-Soft) at http://www.sun.com/sunsoft/solaris/networking/webnfs/.

Bob Friesenhahn is a consulting writer for BYTE who specializes in Unix and TCP/IP networking-related topics. You can reach him at bfriesen@simple.dallas.tx.us.

"They thought my new Multipath" Back-UPS® Office™ was just a big surge suppressor - then the lights went out."



At last, a safe place to plug everything: Multipath Back-UPS Office for workstations, PC's and peripherals



Facing the darkness is hard, but inevitable: You have a better chance of winning the lottery than of escaping

power problems: They're the single largest cause of computer data loss and hardware damage.

Back-UPS Office provides reliable power for your entire system. Instantaneous battery backup ensures uninterrupted operation of your CPU, monitor and an external storage device. Full-time surge suppression and site-wiring fault protection spreads a true Multipath^t safety net under any remaining integrated peripherals, like modems, printers, faxes and phone systems. Back-UPS Office also provides convenient BlockSafe™ outlet spacing to handle all size plugs - even large block transformers.

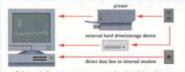
Unique Multipath protection keeps your PC and data safe

Plugging a phone line into your com-puter doubles your vulnerability to power

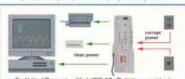
problems; add any peripheral, and it triples. Even if your AC power-line is shielded, when a surge hits an unprotected peripheral, it can blaze down serial and data lines.

Back-UPS Office's compact design installs easily on desktop, floor or mounts to wall. and toast your expensive PC.

Multipath™ Means Total Power Protection



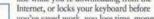
ower (red) can enter a computer system through multiple ; ster, data and phonelfax lines — even if computer AIC is pr



on of Back-UPS® OfficeTM shields your peripheral er from bad power on every poth, providing clean,

peripheral, and instant battery backup to keep your cutting edge system and O/S from crashing. It means protection for less by integrating the security of a surge suppressor with the power of a UPS, guaranteed up to \$25,000.

APC has won more awards for reliability than all other brands combined



Multiple peripherals and data lines to and from your system are

vital, but dangerous. Without them, you can't do your job. However, if

a power sag makes your modem drop the line while you're downloading from the you've saved work, you lose time, money and spend another late night at the office to meet your deadline.

Back-UPS Office protects your entire system

Until now, protection for your entire system required several devices, But multidevice protection can leave you vulnerable to line noise and unwanted data glitches created by the voltage differential between outlets. Those glitches are prevented with the Back-UPS Office common voltage reference.

Back-UPS Office means true Multipath™ protection, clean, safe power to every





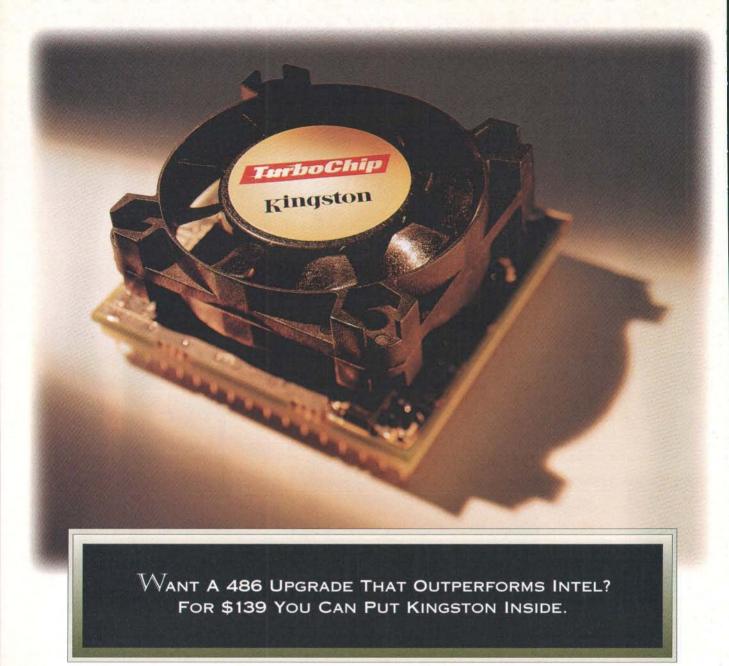
Protect yourself before you kick your-self. Get your new Back-UPS Office today (list price: \$179.99), or call APC for a FREE 60-page catalog!





(800)800-4APC * http://www.apcc.com (401)788-2797 Fax • (800)347-FAXX PowerFax sufferve: GO APCSUPPORT • Email: bkoffloo@apcc.com 32 Fairgrounds Road, West Kingston, RI 02892 USA

Circle 130 on Inquiry Card.





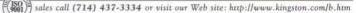
Making your 486 run like a Pentium®doesn't take magic. It just takes a TurboChip™ and a little pocket change. Instantly, you will have 5 x 86 clock-quadrupled

technology that will help your system run three times faster. And the TurboChip has all the power you need to run today's demanding software, whether you have a 486-based DX2, DX, SX2, or SX system. So how does the TurboChip compare to Intel's OverDrive*? Not only does the TurboChip beat the OverDrive in price,

compatibility, and warranty, but in a recent study* it also outperformed it. The TurboChip is designed with AMD's Am 5 x 86–P75 CPU and upgrades with most IBM-compatible desktop systems. And since the TurboChip is a chip-for-chip replacement upgrade, it's easy to install. Plus it preserves your system configuration. To find your nearest Kingston* distributor call us at (800) 251-9059, domestically or (714) 437-3334

For more information call us domestically at (800) 251-9059, or for international









Motorola's embedded PowerPC processor offers a rich set of communications features. By Tom Thompson

The Consumer PowerPC Revisited

otorola intends to expand its reach into the world of personal communications with a slimmed-down variant of the

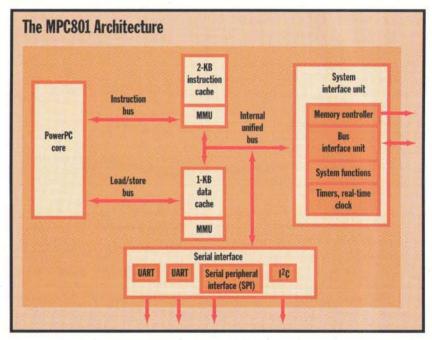
PowerPC called the MPC801. The chip began sampling recently and will be available in quantity late this year. The MPC801's feature set makes it attractive not only for use in communications products such as pagers and cellular phones but also for general-purpose embedded applications and consumer electronics.

The MPC801 is a three-metal-layer, 0.35-micron CMOS part with 800,000 transistors. The fully static 3.3-V chip consists of an embedded PowerPC core plus caches, timers, memory controller, and peripheral support logic. It has four low-power modes that make it suitable for hand-held products, for which long battery life is paramount. If these specifications sound familiar, it's because they're similar to IBM's embedded PowerPC processor, the 401GF (see "The PowerPC Goes Consumer," August BYTE). Upon closer examination, there are significant differences between the two chips.

IBM's 401GF serves primarily as an embedded controller. The MPC801 also acts as controller but, true to Motorola's heritage as a communications company, it sports a rich set of communications features. This includes two serial UARTs and a serial peripheral interface (SPI). (IBM can provide a custom 401GF part that includes a serial I/O interface.)

The heart of the MPC801 is its Power-PC core. It is a 32-bit implementation of the PowerPC architecture. It has thirty-two 32-bit general-purpose registers. Two function blocks, an integer unit and a load/store unit, execute all integer and load/store operations in the hardware.

To reduce the transistor count—which both reduces the processor's size and power consumption—the designers removed a number of features present in the 60x architecture. The floating-point unit is gone, since embedded applications execute mostly integer instructions. Additionally, the core's architecture was simplified so that the core executes The core has two on-chip caches, a 1-KB data cache and a 2-KB instruction cache. The caches are two-way set associative, which helps compensate for any performance hit due to their small size.



Motorola's MPC801 processor has a built-in memory controller and a number of serial functions.

only one instruction per cycle. This compromise eliminates the support logic required to implement multiple execution units. While this approach does exact a performance penalty, the design win is reduced power consumption. To boost performance, the core provides several instruction queues. It also has branch prediction logic that performs branch folding and branch prediction with conditional prefetch. However, in keeping with the goal of a simple, low-power design, the branch logic doesn't do any conditional execution on any prefetched instructions.

Portions of each cache can be locked to hold critical sections of code or frequently used data sets. Each cache has its own memory management unit (MMU). The MMUs support a variety of memory page sizes ranging from 4 KB to 8 MB. They can arrange a maximum of 16 virtual address spaces with 16 protection groups. You can program the MMUs to set the data caches to copyback or write-through modes and inhibit the caching of specific pages in memory (typically for memory-mapped I/O). The combination of the PowerPC core and the caches allows the MPC801 to deliver 33 MIPS at

25 MHz (using Dhrystone 2.1) and 52 MIPS at 40 MHz.

To reduce power consumption, the MPC801 supports four low-power modes: doze, sleep, deep sleep, and lowpower stop. A phase-locked loop (PLL) obtains the processor clock signal, which enables a system designer to dynamically reduce the clock rate to conserve power when a hand-held device is idle.

Interfaces Galore

The MPC801 has a system interface unit (SIU) that enables it to work with a variety of peripherals. It handles dynamic bus sizing to 8-, 16-, and 32-bit wide memory and devices. The SIU's built-in memory controller can generate the signals and timings for SRAM, synchronous static RAM (SSRAM), EPROM, FLASH EPROM, DRAM, self-refreshed DRAM (SRDRAM), and extended data out (EDO) memory. It can manage up to eight separate memory banks. The processor supports a glueless interface to one bank of memory, but additional banks require external buffer logic to maintain the signal levels.

The MPC801 has two on-chip fullduplex serial UARTs. Each of these UARTs can be independently programmed for baud rates ranging from 300 bps to 115.2 Kbps. Eight maskable interrupts assist I/O transfers. Interestingly, these serial ports provide direct support of the IrDA physical layer protocol. IrDA is an infrared beam communications protocol, developed by the Infrared Device Association, that's used to transfer information in some hand-held machines. By implementing the IrDA protocol in the hardware, the MPC801 can reduce the parts count in a hand-held's design, thereby lowering its costs.

The processor also provides two other communications interfaces: SPI and I²C. The SPI is a four-wire, full-duplex, character-oriented interface. It supports 8- and 1-bit character operations, and it can operate in master or slave modes. Like the UARTs, the SPI can also interrupt the processor to expedite data transfers. I2C is a low-speed, full-duplex, two-wire

WHERE TO FIND

Motorola Microprocessor and Memory **Technologies Group** (512) 891-3823 http://www.mot.com/SPS/HPESD/prod/eppc/ MPC801.html

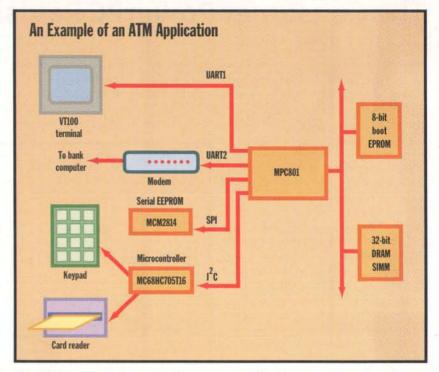
bus that enables the MPC801 to communicate with a variety of controller chips. It, too, supports interrupts.

ATMs and Web TVs

Because of its built-in communications functions, the MPC801 is thus readymade for embedded applications that require such capabilities. It can be used

and hardware configuration settings, which can change over time. The I2C interface directs a microcontroller that scans the teller machine's keypad for key presses and reads the data from the magnetic strip on the customer's ATM card.

Here's the most intriguing application of the MPC801. Mitsubishi Consumer Electronics is using it to convert a 40-inch



The MPC801 can operate the automated teller machine's hardware, display, and communications with the bank computer.

in set-top boxes, cellular base stations, automated teller machines (ATMs), handheld computers, and Internet terminals or network computers. Two examples help emphasize how the MPC801 is an ideal fit for applications that demand extensive communications support. In the figure "An Example of an ATM Application," the MPC801 is shown acting as an embedded controller. The processor operates the hardware and handles the user's interactions with the machine. It can also manage the communications the ATM requires to verify transactions with a remote bank computer. One UART operates a smart terminal that serves as the teller machine's display screen; the other operates a modem that relays transaction data to and from the bank computer. The SPI updates nonvolatile data in a serial EPROM. This nonvolatile data might consist of encryption codes

TV into a Web browsing box called the DiamondWeb TV. Because of the MPC801's glueless interface to memory and to Motorola's Scorpion Graphics processor (which is used to mix text, graphics, and live video), the DiamondWeb TV's parts count-and therefore its cost-can be kept low.

The MPC801 implements a Web browser and a Java virtual machine on the device. Its serial connections help implement the TV's audio, modem, video, and TV monitor interface functions. The DiamondWeb represents the convergence of TV, the Web, and computing in one integrated device. The MPC801's capabilities make it all possible. And affordable. B

Tom Thompson is a BYTE senior technical editor at large. You can reach him at tom thompson@bix.com.



Brilliant performance. Breakthrough price.

The new Phaser* 350 costs less to own, less to use than any other laser-class, workgroup color printer. With award-winning performance that's become the hallmark of Tektronix: RISC processing. Ample RAM. Networking. So now our incredible speed and brilliant color are the most affordable and economical, too. No wonder, at over \$500 million in color printing revenue, Tektronix sells more workgroup color printers than anyone.

Call 800/835-6100, Ext. 1314. http://www.tek.com/CPad?1314

Tektronix















MAXIMIZE YOUR MARKETING DOLLARS WITH BYTE REPRINTS!

Thinnest, Brightest ThinkPad Microsoft Powers Up SQL Server 6.5

Netscape Navigator 3.0: All but the Kitchen Sink

Run Your Business on the Web

BYTE Reprints serve as high-quality, inexpensive promotional tools for:

- · Trade show handouts
- · Direct mail campaigns
- Dealer/distributor promotions
- Training and educating key personnel
- Presentations at conferences/ seminars

And there's more!

and quantity prices.





A new programming model for parallel processing simplifies writing programs and promises code portability. By Dick Pountain

Parallel Processing in Bulk

arallel processing—using more than one CPU to increase computation speed—is one of those cutting-edge technologies that always seems poised to break through into the mainstream. The problem has been that writing software for parallel computers is just too difficult. It requires complex code to synchronize the data and activity of tens or hundreds of processors. Furthermore, because parallel programs aren't portable between different supercomputer architectures, no volume software market has ever taken off to sustain the effort.

A new parallel-programming model, called Bulk Synchronous Parallelism (BSP), promises to remedy this situation. Developed by teams at Oxford in the U.K. and Harvard in the U.S., BSP offers a simple synchronization mechanism. It also has the potential to make parallel programs portable between different parallel-computer architectures.

Parallel's Pitfalls

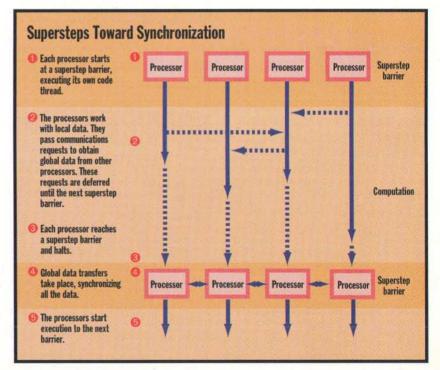
Parallel programming's fundamental problem is that there has been no generally accepted model of what a parallel computer should look like. Some designers have favored distributed-memory machines, whose processing nodes communicate by passing messages. Others have preferred symmetric-multiprocessing (SMP) or shared-memory architectures, where all the processors read and write the same memory.

Yet others have used collections of workstations connected by a LAN to simulate a single parallel computer. The clustering of workstations into virtual parallel computers is immeasurably easier since the emergence of standard messagepassing environments such as Message Passing Interface (MPI) and Parallel Virtual Machine (PVM). Still, moving a program from one type of parallel machine

to another normally involves a complete rewrite of the program.

What's needed is an abstract model of a parallel computer that describes all these schemes, hiding the physical details of particular architectures from programs to make them portable. Another desirable feature of such a model would that efficiently supports a global memory space and a mechanism for the *barrier synchronization* of all the processors. Execution of a BSP program proceeds in phases, and all global communication takes place between phases.

Each phase is called a *superstep*. It consists of a number of parallel-running



BSP's step-by-step scheme simplifies the synchronization of both processors and any shared (global) data.

be predictability (i.e., the ability to accurately analyze how such portable programs will perform on different real architectures). BSP provides just such a model.

BSP's Structure

The BSP model assumes a set of processor/memory pairs. These pairs are connected by a communications network

threads that contain any number of operations. The threads perform only local communication until they reach a synchronization point or barrier. At a barrier, all the threads must wait until the last one becomes ready, at which time all global communication (i.e., accesses to the physical memory of remote processors) takes place, as shown in the figure "Supersteps Toward Synchronization."

continued

This model completely decouples communication from synchronization, so that the synchronization of individual messages ceases to be of concern to the programmer.

BSP doesn't care whether a parallel computer implements barrier synchronization via hardware or software, because this affects only absolute performance. As an example, Cray's T3D, a massively parallel supercomputer based on Digital Equipment Alpha RISC processors, supports hardware barrier synchronization by providing each processor/memory node with a special barrier register.

BSP is equally unconcerned about the underlying mechanism used for communication. Thus, the same program could run on an Ethernet of PCs using the WinPVM library or on a T3D.

BSP Parameters

As important as BSP's support for program portability is the way it provides an analytic cost model for assessing the performance of parallel algorithms. This is something to which synchronized message-passing programs have never been amenable.

Any BSP computer is defined by three parameters: p, the number of processor/memory pairs; l, the latency, or number of time steps consumed by barrier synchronization; and g, a ratio obtained by dividing the total local operations performed by all processors per second by the total words delivered by the communications system per second. Note that g measures only a bulk property of the whole system, not the speed of individual CPUs or links. The l and g parameters are normalized with respect to a fourth parameter, s, the number of time steps per second or MFLOPS rate, so you can compare algorithms running on different hardware.

You can consider any scalable parallel system to be a BSP computer and determine what its *p*, *l*, and *g* parameters are by benchmarking. You can then use these

WHERE TO FIND

Oxford Parallel OUCL Oxford, U.K. +44 1865 273897 fax: +44 1865 273819 oxpar@comlab.ox.ac.uk http://www.comlab.ox.ac.uk results to analyze the computational complexity of both architectures and algorithms. Designers of parallel architectures strive to reduce *l* and *g* to a minimum. Likewise, a programmer's choice of algorithm will try to offset the bad

ory primitives. There are also optimized native libraries for IBM's SP1/SP2, Cray's T3D, Silicon Graphics' Power Challenge, Meiko's CS/2, and other supercomputers.

Oxford Parallel is working on BSP support for SMP machines running Windows

Programming with BSP

BSP doesn't require the invention of any new programming languages. You can write BSP programs in conventional sequential languages such as C or FORTRAN 90. You then link the program to a library that implements a few primitive BSP operations.

The simplest primitives are <code>bsp_put</code> and <code>bsp_get</code>, which are requests for nonlocal data access, and <code>bsp_sync</code>, which marks a barrier for synchronization. Put and <code>get</code> are both one-sided operations, and you don't need to pair them: You either put a value into a remote process or get a value from it, but not both. They do, however, require variables to have the same names in different physical address spaces, so they are most suited for Single Program Multiple Data (SPMD) algorithms.

Other BSP primitives are better suited for different types of parallelism. Put and get are nonblocking, so the process that calls them can proceed immediately, Issuing a put or get guarantees only that the requested data operation will be completed by the end of the superstep or next barrier synchronization.

The C function, bsp_allsums(), hints at the flavor of BSP programming. It calculates the running sums of p integers stored on p processors. Put another way, if integer x + i is stored on processor i, the result on processor i is x + i + i... x + i.

You use the primitives bsp_pushregister and bsp_popregister to register the name of the destination variable left across all the processors. The cost of this algorithm is $\log(p) \times (g+1+1) + 1$, as there are $\log(p) + 1$ supersteps (including one for the registration), and the addition operation costs 1 FLOP.

```
#include "bsp.h"
#include <stdio.h>
#include <stdlib.h>

int bsp_allsums(int x) {
   int i, left, right;
   bsp_pushregister(&left.sizeof(int));
   bsp_sync();

right = x;
for(i=1:i <bsp_nprocs();i*=2) {
   if (bsp_pid()+i < bsp_nprocs())
       bsp_put(bsp_pid()+i.&right.&left.0.sizeof(int));
   bsp_sync();
   if (bsp_pid()>=i) right = left + right;
}
bsp_popregister(&left);
return right;
}
```

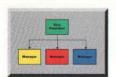
effects of large *l* and *g* inherent in a hardware design.

A Parallel Future

The Oxford University Computer Lab (OUCL) has set up a unit called Oxford Parallel to commercialize and spread the word about BSP. The firm offers the Oxford BSP Library for a number of machines, including a free generic version for any homogeneous parallel Unix machine that has access to PARMACS, PVM, TCP/IP, or System V Shared Mem-

NT and for clusters of NT servers. Such a development would be timely indeed, given that the PC industry is entering an era of multimedia and 3-D graphics applications that cry out to be accelerated by parallel processing. Perhaps after all those false dawns, BSP is the technique that will bring parallel processing into the mainstream for the first time.

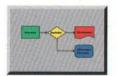
Dick Pountain is a BYTE contributing editor based in London. You can contact him at dickp@bix.com.



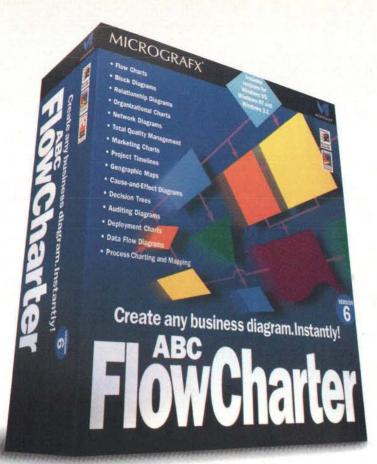
Human resource tools like organization charts and relationship diagrams



Management support diagrams like cause & effect, decision trees and timelines



Business process re-engineering diagrams like flow charts and data flow diagrams

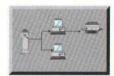




Marketing tools like venn diagrams, targets, pyramids and geographic diagrams



Total quality management diagrams like process charts and maps



IT and software design tools like network diagrams and object oriented design diagrams

ROCKET FUEL FOR THE BUSINESS PROCESS

Great businesses run fast. As fast as you can make obstacles disappear. That's why you need ABC FlowCharter*6. It shows you your business. Clearly. With diagrams that add a boost to your entire business process.

ABC FlowCharter is not just another drawing tool. It actually lets you relate charts to data, and automatically analyze the results. Unlike diagramming tools that hit the wall at the edge of the page, ABC FlowCharter is powerful. It can diagram any process. Across any number of pages. No matter how complex. With lines that re-route automatically and shapes that drop into place. In fact, it's so powerful,

it's used as the engine for Process Model*—the world's most advanced business simulation tool.

ABC FlowCharter does the work, while you work on making your business run better. See for yourself.

Pick up your copy of ABC
FlowCharter 6 today. If you want
even more graphics power,
you'll find ABC FlowCharter
bundled in ABC Graphics Suite."
Visit your favorite reseller, or
call 800-428-8716 now.



www.micrografx.com

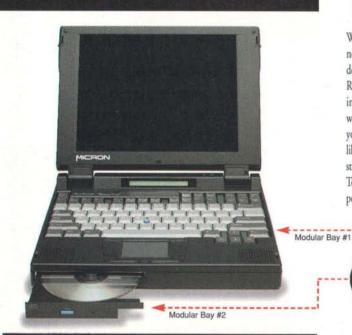








DESKTOP POWER WITH NEW-FOUND FREEDOM.

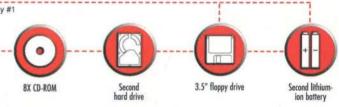


With up to eight hours' battery life* and full multimedia desktop performance, the Millennia TransPort™ puts compact, nocompromise computing where you need it.

Take your work to new heights.

With its exclusive FlexOpt™ dual bay modular design, the Millennia TransPort™ notebook system from Micron Electronics lets you mix and match devices for a variety of customized choices. Drop in a modular CD-ROM drive to enhance multimedia capability. Add a second intelligent modular lithium-ion battery for up to eight hours' use without recharging*, or add a 2.1GB hard drive to more than double your storage capacity. And there's built-in flexibility, with features like the innovative Pick-a-Point™ system offering touchpad or pointing-stick operation and an infrared port for wireless printing from compatible printers.

Top it off with our industry-leading Micron Power™ warranty, and you have the ideal portable computing solution.





- 3-year limited parts-only system warranty
- 1-,2- or 3-year optional on-site service agreement for Micron desktop systems
- 30 days of free Micron-supplied software support for Micron desktop systems
- 30-day money-back policy
- 24-hour technical support

The foregoing is subject to and qualified by Micron's standard limited warranties and terms and conditions of sale. Terms and conditions of sale my vary for specific configurations. Copies of the limited warranties may be obtained on our Web site or by calling Micron.

*Actual battery performance will vary depending on applications and configurations. Based on two 4-hour batteries.



Millennia TransPort™

- 133MHz Mobile Intel Pentium® processor
- 16MB EDO memory (48MB max.)
- 12.1" active matrix color display, 800 x 600
- 1.2GB removable hard drive
- 133MHz Mobile Intel Pentium processor
- 32MB EDO memory (48MB max.)
- Motorola® Montana 28.8 fax/modem
- 12.1" active matrix color display, 800 x 600
- 1.2GB removable hard drive
- · 2nd intelligent modular lithium-ion battery
- 150MHz Mobile Intel Pentium processor
- 32MB EDO memory (48MB max.)
- 12.1" active matrix color display, 800 x 600
- 2.1GB removable hard drive
- Motorola® Montana 28.8 fax/modem
- · 2nd intelligent modular lithium-ion battery
- Samsonite leather carrying case







Business lease \$163/month

Business lease \$189/month

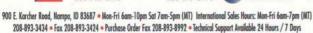












Technical Support E-mail: techsupport.meic@micron.com ©1996 Micron Electronics, Inc. All rights reserved. Micron Electronics is not responsible for omissions or errors in typog (#1998 Micron Electronics, Inc. All rights reserved. Micron Electronics is not responsible for omissions or errors in typo-raphy or photography. All purchases are subject to availability. Proces and specifications may be changed without notice; prices do not include shipping and handling, 30-day money-back policy does not include return freight and original ship-ping/handling charges, applies only to Micron brand products and begins from date of shipment. All sales are subject to Micron Electronics' current terms and conditions of sale. Lease prices based on 36-month lease. Intel, Intel Inside and

Pentium are registered trademarks of the Intel Corporation. Microsoft, Windows the Windows logo and Windows NT are registered trademarks of Microsoft Corporation. All other service marks, trademarks and registered trademarks are the d trademarks are the BYTE-TRANS-9611 property of their respective companies

Circle 175 on Inquiry Card.

Standard Features

- Mobile Intel Pentium processor
- Intel 430MX PCI chipset
- 256KB L2 pipeline burst cache
- 16MB EDO memory (48MB max.)
- · 8X modular CD-ROM drive
- PCI graphics accelerator, 1MB EDO memory
- Pick-a-Point™ dual pointing devices integrate both pointing stick and touchpad
- Removable EIDE hard drive
- 3.5" modular floppy drive
- · Intelligent modular lithium-ion battery
- 16-bit stereo sound
- · Built-in stereo speakers and microphone

- · 2 Type II or one Type III PCMCIA slots
- · S-video and NTSC-video outputs
- · Headphone, microphone and line-in jacks
- · 2 infrared ports; one front, one back
- Parallel, serial, VGA and 2 PS/2 ports
- Dimensions: 11.7" x 9.4" x 2.0", Weight: 6.9 lbs.†
- Nylon carrying case
- Microsoft® Windows® 95 and MS® Plus! CD
- Microsoft Office Pro 95 and Bookshelf® 95 CDs
- Kensington™ security lock ready‡
- 5-year/3-year Micron Powersm limited warranty* † 6.9 lbs. includes 3.5" floppy and one battery ‡ Lock secures both Millennia TransPort and MicronDock*

Ontions:

o priorior
With 150MHz Mobile Intel Pentium processor add \$200
• With 2nd removable hard drive (1.2GB)
With 2nd removable hard drive (2.1GB)
With 16MB DIMM module upgrade add \$349
With 32MB DIMM module upgrade
With 3Com® 10BT IDBT PCMCIA
• With Motorola® Montana 28.8 PCMCIA fax/modem add \$259
With MicronDock™
With MicronExec™ and \$799

ELECTRONICS, INC.

http://www.mei.micron.com

State of the Art

Tomorrow's CPUs

The hard part will be choosing among major new chip platforms and families; easier to take will be the blazing speeds of tomorrow's processors.

onventional wisdom says that Intel dominates the desktop CPU market. But look at the company's development plans for the next year, and you'll see a corporation that's acting a lot more like a hyperactive start-up than a sleepy giant.

Why? The CPU decisions we make will fuel a fundamentally new battle among processor architects. Some RISC-chip vendors are developing a new family of processors designed from the ground up to run Java applications at optimum speed. BYTE obtained exclusive technical details about Sun's picoJava architecture, which will provide the underpinnings for some Java chips that should ship next year. Early tests using Java-chip simulations point to significant speed advantages over general-purpose CPUs that use interpreters or just-in-time compilers to run Java code.

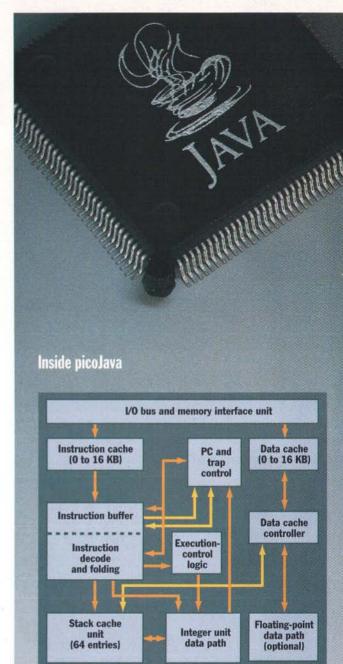
Intel hasn't announced Java-specific architectural changes for its processors, but it's not standing still, either. Over the next 12 months, the company will introduce three major new chips, including the first Pentium Pro to break the 300-MHz barrier. Stretch your sights into 1998, and you begin to see Intel's seventh-generation processor, the secretive Merced joint project with Hewlett-Packard.

Intel has good reason to continue to innovate. Even if Java chips never take off, we expect to see nine new x86 chips from AMD, Cyrix, and the lesser-known IMS. At the same time, the PowerPC Alliance is redoubling its efforts to develop pace-setting chips and a hardware standard that will spawn PowerPC systems for the Mac OS, Windows NT, and Unix.

Myriad CPU choices may be confusing at first, but if you choose wisely, your next computer might give you the fastest performance ever for the applications that are important to you. In relative terms, your next processor will deliver this performance at a bargain price. If you choose badly, however, you may be shackled with a processor that's blazingly fast for some applications but a slouch for others. If that happens, no price is a bargain.

The following stories can help you find your next CPU and begin to plan for the generation after that. In the end, you may long for the days when you needed only to compare clock speeds to find the right chip.

-Alan Joch



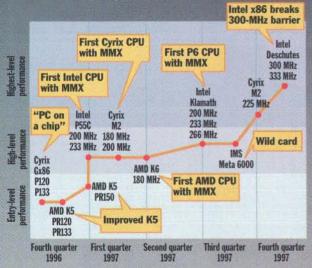
EXCLUSIVE

Sun Gambles on Java Chips...79

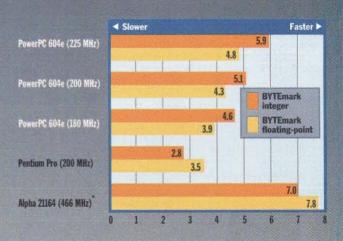
An innovative interpretation of RISC design could produce Java-specific processors that transform computing...



The x86's Growth Spurt



PowerPC Overpowers x86



For comparison. Alpha scores are fastest BYTEmark scores to date. From BYTEmark run on Windows NT.

The x86 Gets Faster with Age...89

...while Intel and a host of competitors plan a dizzying number of introductions in the next year intended to maintain the x86's dominance...

PowerPC Regroups...101

... and the PowerPC Alliance continues to push the performance envelope for general-purpose computers.





Based on a full-custom ASIC utilizing 2500-gate, 1.5-micron E2 technology, HASP packs the most advanced protection into the smallest key in the world.

NSTL Study Rates



Testing Labs, the world's foremost independent lab, compared the flagship products of leading software protection vendors.* The result? HASP was rated the clear overall winner - and number one in all the major comparison categories.

NSTL TEST RESULTS, OCTOBER 1995

Scoring Category	Aladdin HASP	Rainbow Sentinel
Security	9.3	6.3
Ease of Learning	9.1	7.1
Ease of Use	8.3	7.2
Versatility/Features	10	8.7
Compatibility	6.7	6.5
Speed of API Calls	0.9	1.2
Final Score	8.5	6.5

*For a full copy of the NSTL report, contact your local HASP distributor.

Int'l Office

Germany

Japan

Benelux

PROTECTS MORE.

These days, more and more developers are choosing to protect their software against piracy. They're protecting more products, on more platforms, with better protection - and selling more as a result.

And more of these developers are protecting with HASP. Why? Because HASP offers more security, more reliability and more features than any other product on the market.

HASP supports the most advanced platforms, including all Windows 32/16-bit environments, OS/2, DOS, Mac, Power Mac, NEC, UNIX and LANs.

To learn more about how you can protect better – and sell more – call now to order your HASP Developer's Kit.

Grow With Aladdin!

The fastest growing company in the industry, with over 4 million keys sold to 20 thousand developers worldwide, Aladdin is setting the standard for software security today.











1-800-223-4277 www.aks.com



North America Aladdin Knowledge Systems Inc. Tel: (800) 223 4277, 212-564 5678, Fax: 212-564 3377, E-mail: hasp.sales@us.aks.com Aladdin Knowledge Systems Ltd. Tel: +972-3-636 2222, Fax: +972-3-537 5796, E-mail: hasp.sales@aks.com FAST Software Security AG Tel: +49 89 89 42 21-37, Fax: +49 89 89 42 21-40, E-mail: info@fast-ag.de United Kingdom Aladdin Knowledge Systems UK Ltd. Tel: +44 1753-622266, Fax: +44 1753-622262, E-mail: sales@aldn.co.uk Aladdin Japan Co., Ltd. Tel: +81 426-60 7191, Fax: +81 426-60 7194, E-mail: sales@aladdin.co.jp Aladdin Software Security Benelux B.V. Tel: +31 24-641 9777, Fax: +31 24-645 1981, E-mail: 100526.1356@compuserve.com The Professional's Choice

■ Aladdin Russia 095 9230588 ■ Australia Coviab 03 98985685 ■ Chile Micrologica 02 7350041 ■ China Stranghai LPR 021 64377828 ■ Czech Altas 02 766085 ■ Denmark Berendsen 039 577316 ■ Egypt Zeineldein 02 9804632 ■ Finand ID-Systems 0 8703520 ■ France 1 40859885 ■ Greece
Uniterian 01 6756320 ■ Hong Kong Hastings 02 5484629 ■ India Solution 011 2148254 ■ Italy Partiner Data 02 25147380 ■ Korea Dae-A 02 8484481 ■ Mexico StSott 5 2007472 ■ New Zealand Training 04 5956014 ■ Poland Systherm 061 481223 ■ Portugal Futurmatica 01 4116289
■ Romania Ro Interactive 064 140283 ■ Singapore ITR 065 5666788 ■ South Africa D Le Roux 011 8864704 ■ Spain PC Hardware 03 4493193 ■ Switzerland Opag 061 7169222 ■ Taiwan Teco 02 5559676 ■ Turkey Mikrobeta 0312 4670635 ■ Tugoslavia Asys 021 623920

State of the Art

Are Java chips better than general-purpose CPUs? Or will new compilers make them obsolete? By Peter Wayner

Sun Gambles on Java Chips

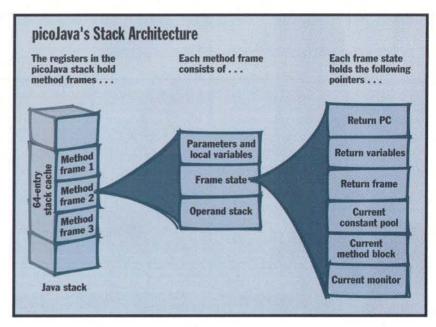
ownload a small Java application from the Internet today and your trusty x86 or RISC processor won't blink. These CPUs are designed to optimally run C-based applications, but they also work well at emulating the Java virtual machine (VM) for the simple Web-based applets we're seeing now.

Life is good, as long as Java spawns nothing more complicated than cute dancing applets on Web pages. But Java has the potential to become much more. Its cross-platform compatibility is motivating some software companies, such as Corel, to develop large-scale business applications entirely in Java.

Suddenly, our decisions about which CPU platform to buy may become twice as difficult. Do we stick with a general-purpose processor and hope it will run tomorrow's Java applications efficiently? Or do we bank on a new generation of processors built from the ground up for fast Java performance?

Sun Microsystems, the company that launched Java, is betting on dedicated Java chips to deliver the performance needed for Java-based business and embedded applications. To this end, Sun is developing a core specification known as picoJava-for Java chips. BYTE has exclusively obtained the spec prior to its public release. The architecture outlines a number of design innovations for optimally running Java code. At prices that fall below \$100 for even the most expensive versions of these chips, Sun hopes the price and performance characteristics of Java processors will both ride on and help power the Java wave. Chips based on Sun's pico Java core architecture should appear early in '97 and make their way into commercial products by the end of the year. Sun also wants to license the pico Java core design to other companies that want to produce their own Java chips.

Sun's strategy is compelling but not airtight. Platform-specific processors have



The picoJava stack uses 64 32-bit registers. picoJava allocates variables on the stack; method calls pass data through the stack.

been tried before with mixed results. And some competitors believe they can enhance their existing processors to boost Java performance without resorting to Java-specific chips.

Either way, we're watching the opening volley of a technical war that may take months or even years to resolve. While many questions will remain unanswered until we see actual silicon, we can begin to sort out the technical merits of Java chips today.

Two Flavors

Sun's picoJava architecture will be the foundation for the first-generation Java chips, known as microJava, a low-cost (approximately \$25-\$50) family for resource-stingy embedded applications. Typical applications might include industrial data-acquisition devices, PDAs, cellular phones, set-top boxes, and low-cost network computers.

Sun is also developing a more expensive (approximately \$100) chip called

ultraJava, which will be for desktop systems. Sun officials won't say whether or not ultraJava chips will use a picoJava core. However, these chips could include multimedia capabilities such as JPEG decompression and the graphics-processing optimizations now found in Sun's UltraSPARC RISC processors.

BYTE couldn't obtain actual silicon samples of Sun's Java chips at press time, so we don't know how well pico-Java succeeds at boosting Java performance. According to Sun, these chips will run Java programs about 12 times faster than the same code executed by Sun's current Java interpreter. (See "Preliminary Speed Tests," page 80.) But Java bytecode interpreters are getting better, too. For instance, Intel has written its own Java interpreter for the x86 series and claims it runs Java code three times faster than Sun's interpreter.

Just-in-time (JIT) compilers can run Java code even faster than interpreters, but Sun says the pico Java chips could be

five times faster than a Pentium with a IIT compiler. However, Sun concedes that it still isn't certain how much picoJava's hardware improvements for thread synchronization and garbage collection will contribute to the overall speed of Java chips. Sun officials are optimistic about seeing performance improvements in these areas once they test actual silicon. Nevertheless, the actual performance improvement you get will depend on whether the Java program is heavy on computation and light on object juggling. Applications that require more system overhead may see a smaller performance improvement.

Sun is pinning much of its hopes on the developing market for Java-based embedded devices. MicroJava chips could fit well onto tiny platforms, thanks to their memory efficiency. Since a Java chip will natively execute Java bytecode without converting it to another CPU instruction set, it doesn't need the extra memory or cache space that's required when a general-purpose processor runs a Java bytecode interpreter or IIT compiler. Also, the bytecode is generally smaller than that for a RISC processor. For example, Java bytecode averages 1.8 bytes per instruction (without the tables for dynamically linking the code during method calls), while RISC code generally requires 4 bytes per instruction.

Pushing the Stack

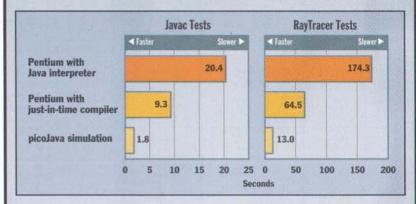
What makes pico Java chips different from other processors? Foremost is how pico Java refines the stack. In the pico Java architecture, Java chips allocate variables locally on the stack, and method calls and bytecode operations also pass data through the stack.

Most C compilers convert C source code into a stack-based language, but the compilers then go through an addition-

Preliminary Speed Tests

When we went to press, chips based on Sun's picoJava core architecture didn't exist, so we were unable to evaluate performance of these dedicated processors. However, preliminary statistics from internal Sun tests indicate that Java chips could deliver significantly better performance than today's two main alternatives for running Java code; using a Java interpreter or a just-in-time (JIT) compiler with a general-purpose processor.

Note, however, that while Java chip advocates are finishing their core designs, developers of Java interpreters and JIT compilers are creating new and faster versions of these technologies. So view the following numbers as snapshots: The competition to deliver faster Java performance will continue to heat up over the coming months.



How Sun Tested: Javac is Sun's JDK 1.0.2 javac compiler for the RayTracer benchmark. It consists of 25,000 lines of Java code (with comments) in 170 different classes. The Java bytecode totals 422 KB. The RayTracer benchmark generates an image of a 1400-triangle dinosaur standing on a glossy table. RayTracer is a 3500-line Java program in 32 classes. The bytecode totals 36 KB.

The picoJava simulator is 100 MHz, with 4 KB of direct-mapped instruction cache and 8 KB of two-way data cache and no off-chip cache. The FPU is present. DRAM is 120-ns latency.

The test Pentium machine was a Hewlett-Packard Vectra VL 5/166 Series 4, with 32 MB of RAM and 256 KB of off-chip cache. The interpreter is Sun's JDK 1.0.2 for Win 95/NT. The justin-time (JIT) compiler is Symantec's Cafe 1.5 for Windows 95 and NT.

All the times were scaled to 100 MHz to match the picoJava simulator output. Thus, times for the Pentium system were multiplied by 1.66. The picoJava simulator does not accurately simulate I/O, so 0.8 seconds were added for the Javac benchmark for I/O, and 0.4 seconds for I/O were added to the RayTracer benchmark results. The effects of garbage collection were also minimized by sizing the amount of memory allocated by Java for the program. By allocating a large amount of memory for the benchmarks, garbage collection was never invoked.

al step of converting this intermediate language into native RISC code (see "RISC vs. CISC" on page 82). This allows the compiler to analyze the flow of data and keep the most essential elements in the CPU registers. A standard RISC processor

simulates a stack machine by loading or storing data from the stack into registers, then using one of the registers to represent the stack pointer. This operation is simple, but the number of registers limits the opportunities for optimization.

continued

Three Alternatives for Running Java Software

Java interpreters

Like a translator at the United Nations, Java interpreters translate Java bytecode into native instructions the CPU understands. Interpreters convert bytecode on-the-fly and must process the same code over and over again when you run the Java program. Java interpreters usually run slowly, sometimes at only 3-10 percent the speed of compiled C code.

Just-in-time (JIT) compilers

Just-in-time (JIT) compilers translate Java bytecode into native code like interpreters do, but they don't have to translate the same code over and over again because they cache the native code. This can result in significant performance improvements, but sometimes a JIT compiler takes an unacceptable amount of time and memory to do its job.

Java chips

Dedicated Java processors, like those that will be based on Sun's picoJava core architecture, natively understand Java bytecode without the overhead of an interpreter or JIT compiler. Proponents say native-code processing and Java-centric optimizations yield the best possible performance for more complex Java applications that might be on the horizon.

STATISTICA (automatically configures itself for Windows 95 [long file names, etc. or 3.1) A complete data analysis system with thousands of onscreen customizable, presentation-quality graphs fully integrated with all procedures Comprehensive Windows support, OLE (client and server), DDE, customizable AutoTask toolbars, pop-up menus Multiple data-, results-, and graphwindows with data-graph links . The largest selection of statistics and graphs in a single system; comprehensive implementations of: Exploratory techniques with advanced brushing; multi-way tables with banners (presentation-quality reports); nonparametrics; distribution fitting; multiple regression; general nonlinear estimation; stepwise logit/probit; general ANCOVA/MANCOVA; stepwise discriminant analysis; log-linear analysis; confirmatory/exploratory factor analysis; cluster analysis; multidimensional scaling; canonical correlation; item analysis/reliability; correspondence analysis; survival analysis; a large selection of time series modeling/forecasting techniques; structural equation modeling with *Monte* Carlo simulations; and much more On-line Electronic Manual with comprehensive introductions to each procedure and examples - Hypertext-based Stats Advisor expert system Workbooks with multiple AutoOpen documents (e.g., graphs, reports) Extensive data management facilities (fast spreadsheet of unlimited capacity with long formulas, *Drag-and-Drop*, *AutoFill*, *Auto-Recalculate*, split-screen/variable-speed scrolling, advanced Clipboard support, DDE links, hot links to graphs, relational merge, data verification/cleaning) Powerful STATISTICA BASIC language (professional development environment) with matrix operations, full graphics support, and interface to external programs (DLIs) Batch command language and editable macros, flexible "turn-key" and automation options, custom-designed procedures can be added to floating Auto Task toolbars All output displayed in Scrollsheets" (dynamic, customizable, presentation-quality tables with instant 2D, 3D, and multiple graphs) or word processor-style report editor (of unlimited capacity) that combines text and graphs = Extremely large analysis designs (e.g., correlation matrices up to 32,000x32,000, unlimited ANOVA designs) = Megafile Manager with up to 32,000 variables (8 Mb) per record Unlimited size of files; extended ("quadruple") precision; unmatched speed - Exchanges data and graphs with other applications via DDE, OLE, or an extensive selection of file import/export facilities (incl. ODBC access to virtually all data bases and mainframe files) Hundreds of types of graphs, incl. categorized multiple 2D and 3D graphs, ternary 2D/3D graphs, matrix plots, icons, and unique multivariate (e.g., 4D) graphs Facilities to custom-design new graph types and add them permanently to menus or toolbars On-screen graph customization with advanced drawing tools (e.g., scrolling and editing of complex objects in 32x real zoom mode), compound (nested) OLE documents, Multiple-Graph AutoLayout Wizard, templates, special effects, icons, page layout control for slides and printouts; unmatched speed of graph redraw ■ Interactive rotation, perspective and cross-sections of 3D displays ■ Large selection of tools for graphical exploration of data: extensive brushing tools with animation, fitting, smoothing, overlaying, spectral planes, projections, layered compressions, marked subsets Price \$995.

Quick STATISTICA (for Windows) A subset of STATISTICA; comprehensive selection of basic statistics and the full analytic and presentation-quality graphics capabilities of STATISTICA Price \$495.

STATISTICA/QC - Industrial statistics add-on package (requires STATISTICA or Quick STATISTICA for Windows) . The largest selection of industrial statistics in a single package; quality control charts (compatible with real-time data acquisition systems), process capability analysis, R&R, sampling plans, and an extremely comprehensive selection of experimental design (DOE) methods Flexible tools to customize and automate all analyses and reports (incl. "turn-key" system options, and tools to add custom procedures) Price \$495.

STATISTICA/Mac (for Macintosh) Price \$695 (Quick - \$395).

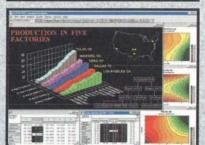
Domestic sh/h \$12 per product; 30-day money back guarantee.

STATISTICA has received the highest rating in EVERY comparative review of statistics software in which it was featured, since its first release.

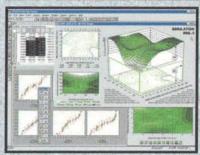


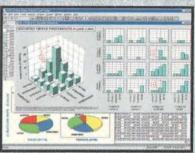
2300 E. 14th St. . Tulsa, OK 74104 . (918) 749-1119 Fax: (918) 749-2217 · WEB: http://www.statsoft.com e-mail: info@statsoft.com

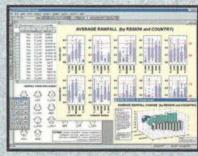
Overseas Offices: StatSoft of Europe (Hamburg, FRG), ph: 040/ 4200347, fax: 040/491310; StatSoft UK (London, UK), ph: 1767/600166, fax: 1767/600144; StatSoft France (Paris, France), ph: (1) 34 52 39 22, fax: (1) 34 52 28 48; StatSoft Polska (Krakow, Poland), ph: 12-391120, fax: 12-391121; StatSoft Libialia (Padova, Italy), ph: 49-893-3227, fax: 49-893-2897; Available from other Authorized Representatives worldwide: Australia: Hearne, ph: (03) 9602 5088, fax: (03) 9602 5050; Sweden: AkademiData Scientific, ph: 018-210039; Finland: Statcon Oy, ph: 24-7334678, fax: 24-7333867; Belgium: Texma NewTech, ph: 010 616 628, fax: 010 619 6957; South Adrica: Osina, ph: 12-660-2886; Japan (Macintosh): Three's Company, Inc., ph: 03-3770-77600, fax: 03-3770-7784; Japan (Windows): Design Technologies, Inc., ph: 03-3667-1110, fax: 03-3668-3110; Taiwan: Intelligent Integration Corp., ph: 2698-2061; The Netherlands: Existal, ph: (0) 50-52677665; Bussia: SoftLine Corp., ph: (985) 126-9065, fax: (095) 232-0023; Hungary: CheMicro, ph: 1 131-3847, fax: 1 132-9330. StatSoft, the StatSoft logo, STATISTICA, and Scrollsheet are trademarks of StatSoft, Inc.

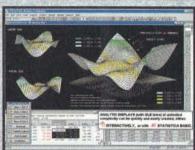


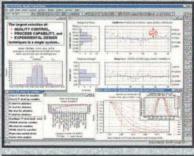


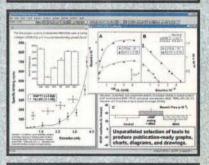


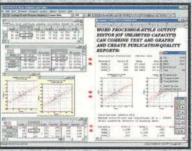












The pico Java architecture uses a stack of sixty-four 32-bit registers with a pointer to the top register on the stack (see "pico Java's Stack Architecture" on page 79). If you have 20 registers allocated for a particular stack frame (call it method A), then a call to another method (B) would begin using register 21. The pointer to the top of the stack would move down from 20 to the last register used by method B.

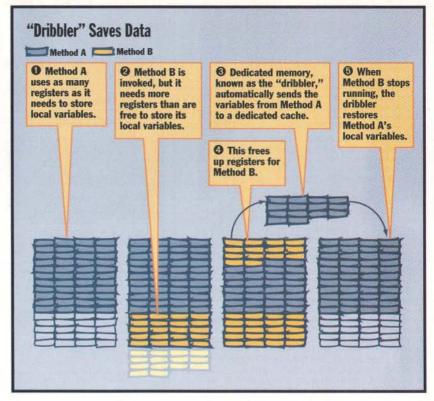
Smart Cache

Sun architects devised a clever method of caching data if all the registers are full (see the figure at right). For example, when you invoke method B, the picoJava register file allocates all remaining empty registers and carries over to register 1 if additional space beyond 64 is required. What happens to the method-A data in those registers if method B quits running and method A resumes? Something Sun calls the "dribbler" steps in from the background to restore the method-A data. The dribbler constantly reads and writes data from the 64 registers to a copy that's kept in memory. So when method B grabs the additional registers, the dribbler has already copied the data. (If for some reason the dribbler hadn't vet made a copy, the Java chip would pause any processing tasks until the dribbler fin-

RISC vs. CISC

How does the x86 stack up against RISC chips when running Java? Interestingly, the ancient x86 has a few advantages. For example, the x86's PUSH and POP instructions could become more valuable. These combination instructions were some of the first to go with RISC. They were replaced by two instructions: a register increment or decrement followed by a load or a store. So the x86 might handle Java stack operations more efficiently than some RISC processors.

One big difference between RISC and CISC is the number of general-purpose registers for storing integer and floating-point values. RISC chips typically have 32 or 64 registers, while the x86 has only 16. Normally, this puts the x86 at a disadvantage. But Java is a stack language; all the information between subsequent instructions is kept on a stack. RISC registers offer no great advantage unless a just-in-time (JIT) compiler can schedule the use of the registers more efficiently.



Sun's "dribbler" is a clever method of caching data and returning it to the stack when registers become full.

ished this operation.) When method B stops running and gives up the registers, the dribbler restores the data to the stack, so method A is current.

The dribbler takes advantage of the fact that the data traffic between the registers and its image in memory is highly predictable. System designers are able to easily tune a cache to anticipate the requests of the dribbler and make sure the necessary data is available in the local data cache when it needs to be.

The flexible register approach of pico-Java contrasts with the simple register files of RISC processors. Java's dribbler dynamically tries to keep all the local variables available in fast registers. RISC chips, on the other hand, rely upon the compiler to orchestrate the movement of information in and out of the chip. Static register allocation works well with scientific code, which may have complicated loops that use each piece of data in multiple calculations.

A robust compiler may find a way to unroll the loops and arrange the flow of data in and out of the registers. The compiler might also be able to leave data in a register in cases where the data needs to be reused 50 cycles later.

The picoJava stack is not well suited for leaving data around or for pushing information deeply onto the stack so it can reemerge at the right time. (Smart compilers that do this magnificent optimization for scientific code should be able to do the same for Java code by creating faux local variables that act like registers.)

However, the pico Java stack can shine with code that calls many short procedures that are constantly starting and stopping. These function calls are constantly clearing and filling data in registers. The Java stack handles these chores in the background, with the dribbler keeping the register file accurate.

The stack at the center of the Java virtual machine is a simple conceit that makes it easy to pack code. This design challenges RISC machines and their ability to speed the flow of data by using registers in a smart way. A Java interpreter can't anticipate the flow of data through the stack, so it can't use the registers for much more than a temporary image of the very top of the stack. Just-in-time compilers may be able to do the analysis necessary to use the registers more effi-

INTERNET/INTRANET ACCESS ROUTER

for instant Internet/Intranet connectivity

COST COMPETITIVE

for small and medium-sized networks

NO HASSLE INSTALLATION

compact, easy to use

http://www.rad.com

ATTENTION: Internet Service Providers and Network Managers.

WIB RANGER

WEB RANger™ is a compact IP access router that connects small or medium-sized offices to the Internet or private IP networks over ISDN, dial-up links, leased lines and digital data services. Designed for fast, no fuss installation and setup, the WEB RANger's attractive price makes it the ideal Internet access solution for ISPs and corporate network managers alike.

For more information contact RAD Data Communications at http://www.rad.com



Compatible with 3rd party PPP devices



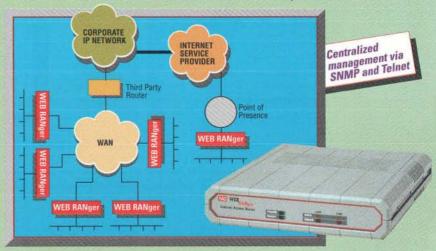
Firewall security feature protects your network's data



Easy installation and setup



Connection On Demand (COD) significantly reduces WAN



International — Tel: 972-3-6458181, Fax: 972-3-6498250, e-mail: michal. g@radmail.rad.co.il

U.S. — Tel: (201) 529-1100, Fax: (201) 529-5777, e-mail: market@radusa.com

Far East — Tel: 852-25270101, Fax: 852-25284761, e-mail: radfejsz@hk.super.net
Latin America — Tel: 54-1-3714000, Fax: 54-1-371044, e-mail: radfejsz@hk.super.net
Latin America — Tel: 54-1-3714000, Fax: 54-1-371044, e-mail: radmaila@server1.startel.com.ar

Scandinavia and Holland — Tel: 45-44853885, Fax: 45-44853889, e-mail: janmkt@vip.cybercity.dk

Brazil — Tel: 011-893-7174, Fax: 011-893-7219, 893-7979, e-mail: radbr@uninet.com.to

France — Tel: (01) 60913432, Fax: (01) 60913423, e-mail: danle@radfr.grollec.fr

Germany — Tel: 069-66554414, Fax: 069-66554100, e-mail: 101336.364@CompuServe.com

U.K. — Tel: 01494-443315, Fax: 01494-443317, e-mail: 100606.3405@CompuServe.com

Copyright 1986, RAD Data Communications. All registered and unregistered trademarks are the sole property of their respective companies

RAD

data communications

Circle 716 on Inquiry Card.

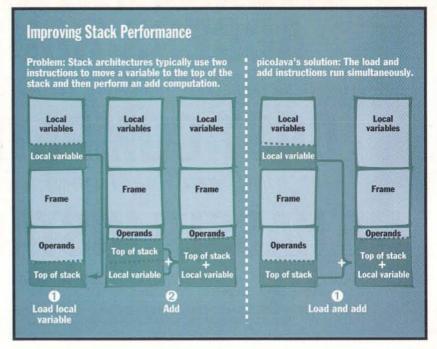
ciently, but spending time on this kind of analysis would end up undermining their effectiveness.

Stack Efficiency

The pico Java architecture wrings out efficiency in another important way: It can dispatch simultaneous instructions when you need to move a local variable to the top of the stack and perform some computation on it (see the figure at right). If the instructions were not dispatched simultaneously, the data would be consumed immediately after it's written to the top of the stack. PicoJava issues the move and the arithmetic operation together so they execute at the same time without disturbing the stack, writing over a register, or forcing the dribbler to do anything. This reduces memory accesses and potentially cuts execution time.

Early reports from Sun indicate that the effect of simultaneous instructions can be dramatic. According to Sun's code analysis, stack operations account for 43 percent of all operations a picoJava-based chip performs. If you combine instructions, stack operations drop to 29 percent of the tasks done by a Java chip.

A persistent challenge in the design of all CPUs is how to manage the flow of data through the system. A modern RISC processor typically has two levels of cache that pull data in and out of main memory. The main memory, in turn, acts as a cache for a much larger amount of virtu-



A picoJava chip moves data to the top of the unused registers in the stack and simultaneously dispatches a computation instruction.

al memory on the hard disk. Ordinarily this combination works to keep the most needed information as close as possible to the CPU, based on the assumption that the most recently accessed data is the most likely to be accessed again.

Garbage collection, in which the processor examines all objects and determines which ones are not in use, can ruin this scheme. This exhaustive search can destroy all the work that the cache and the virtual memory controller have done to keep the most current and important data close to the CPU. Suddenly, *all* objects are the most recently accessed. This can be a real problem if the Java garbage collector runs as a concurrent thread, as it often does.

The simplest solution is to allow the software to turn parts of the cache on and off. This can help manage the stack because the top of the stack—more so than the bottom—is likely to be accessed next. Many RISC chips use this method of cache control.

A bigger problem results because even the simplest garbage-collection mechanism cannot be interrupted by normal system tasks. If garbage collection is interrupted, the list of referenced and unreferenced memory might be corrupted and good information thrown away. To guard against this, pico Java maintains a tag bit, known as a write barrier, on each object. This barrier allows garbage collection to operate in the background and practically eliminates the effect it can have on running code when the entire machine pauses to identify unreferenced memory.

Streamlined Pipeline

For optimum performance, any CPU design must balance the computational

Unanswered Questions

Architectural diagrams reveal a lot about picoJava, but a number of questions remain unanswered until we have live systems.

Q: How fast will systems based on Java chips run compared to PCs with generalpurpose CPUs?

A: Sun says Java chips might run Java code 12 times faster than bytecode interpreters. But Java chips currently exist only as simulations, and new generations of general-purpose CPUs, Java interpreters, and just-intime (JIT) compilers are closing the performance gap.

Q: Can Java chips satisfy multiple demands?

A: With an advanced TV set-top box-a prime potential application for Java chips-you could run Java applets from the World

Wide Web or play videogames. But the latest home videogame machines could do this, too. Some of these boxes are surprisingly powerful and are easily capable of running a fast JIT compiler on their general-purpose RISC processors.

Q: How important will Java become?

A: Java has the potential to become a standard for broad-based application development. The more specialized (but still significant) embedded-systems market may become even more important for Java.

Q: How will Java evolve?

A: If Java does become a foundation for a broad range of application software, the size and structure of Java bytecode could change, and hardware architects would need to adjust their designs.

Watcom C/C++. Performance on any Platform.



Watcom C/C++ accelerates development of lightningfast, multi-platform 16 and 32 bit applications. Reliable, high-performance

code generation and consistent C and C++ language implementation are delivered across all supported platforms, making it easy to develop applications for several targets from a common source code base. In a single package, Watcom C/C++ provides a comprehensive development environment with the tools, SDKs and libraries you need to create powerful applications for popular PC platforms including Windows*, OS/2* Warp, Windows* 95, and Windows NT**.

To find out more about
Watcom C/C++, call us at 1-800-265-4555
or visit http://www.powersoft.com



Circle 172 on Inquiry Card.

Watcom C/C++ v10.6 Features

- Target Platforms: Windows 95, Windows NT, Windows 3.x, Win32s, OS/2 Warp, OS/2 2.x, Extended DOS, Novell NLM, OS/2 1.x, DOS
- 16 and 32 bit C and C++ compilers with industryleading optimization technology
- Comprehensive MFC support with source, samples, and documentation
- Visual Programmer by Blue Sky Software for rapid MFC application development
- Multi-platform toolset with a consistent interface across multiple platforms

State of the Art Sun Gambles on Java Chips

power of each instruction so it can efficiently pipeline the code. Pipelining splits an instruction into several parts, with each part taking the same amount of time to process. This allows a superscalar (multipipelined) CPU to process several instructions simultaneously.

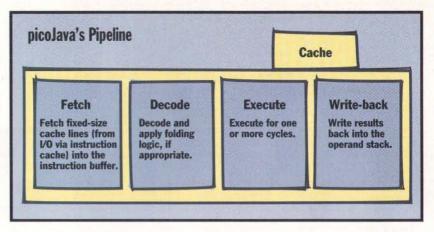
For pipelining to work, all the data needed for a computation must be in the right place at exactly the right time. RISC pipelines driven by optimizing compilers have done this quite well, and Sun uses a very RISC-like pipeline for picoJava. The pipeline has only four stages: fetch, decode, execute, and writeback (see "picoJava's Pipeline" at right).

The chip accesses the cache during the execute phase, which can also perform some addition operations. For example, some Java instructions demand that you access a field of an object by adding *n* bytes to the pointer at the start of the object. These Java instructions execute in the picoJava pipeline as one instruction.

Sun is hoping that an innovative stack architecture, a tweaked garbage-collection mechanism, and a stripped-down pipeline design will add up to fast performance for picoJava chips.

Do We Need Java Chips?

The great potential of Java has generated enthusiasm throughout the computer industry. However, not everyone believes dedicated Java chips are necessary. After all, university researchers have built



To get data in the right place at exactly the right time, picoJava uses a simple, RISC-like pipeline with only four stages.

specialized chips for languages such as LISP or Smalltalk only to discover that software implementations running on RISC chips offered superior performance.

Some chip vendors say their existing RISC and CISC architectures can handle Java quite well. Advanced Risc Machines (Cambridge, U.K.) tuned its StrongARM architecture (see "StrongARM Tactics," January BYTE) for embedded applications and stack-based languages, such as Java and PostScript. The StrongARM can move a stack frame in and out of the register set with a single instruction, according to Dave Jaggar, ARM's technical marketing director. By itself, this probably won't make Java programs run any faster,

Vital Statistics

Estimated picoJava die: .35 microns
picoJava core = 8.0 mm²
optional FPU = 5.5 mm²
Total 13.5 mm² *

*Total size without the instruction or data caches, which are both variable from 0 to 16 KB.

but it does conserve system resources and use the cache more efficiently.

Other processors will soon ship with subtle Java enhancements. The Mips division of Silicon Graphics is working on improvements to its Rx000 architecture that could speed up Java programs. These enhancements will save memory and bandwidth and help speed the interpretation of Java code. The Rx000 will probably use a single instruction to transfer a set of bytes from the stack to the registers while incrementing the stack pointer. Mips officials believe that users of Silicon Graphics workstations, set-top boxes, and videogame machines require computational performance first and Java prowess second. "We want to concentrate on evolving the Mips architecture," says Derek Meyer, director of international marketing and sales. "Java performance will follow."

Some embedded-systems developers are both encouraged and skeptical about Java. "There's a direct relation between Java and the Internet, and this has a lot of potential for embedded applications," says George Nicol, president of Silicon Composers (Palo Alto, CA). One idea his company has been investigating is to

Java vs. C

Designing a dedicated chip to run Java software is very different than designing a RISC chip to run C code. Here's why.

- Java is much more regimented than C. The Java virtual machine (VM) stores all its temporary data, including the results of each computation, on a stack. C uses a stack optionally.
- C compilers rarely know much about the pointers they manipulate. Java objects, by contrast, have a type from a strictly defined hierarchy, and this type information is available to the processor. The Java bytecode interpreter uses the structured information for security purposes and to optimize the code.
- Java centrally controls memory by allocating and reclaiming memory for all objects. Central control means engineers can tune the memory/processor interface to keep

- the most important information available to the CPU. By contrast, RISC chips offer little support for memory control and simply rely upon the cache to deliver the data at the right time.
- Java dynamically links procedure calls and method invocations at run time. This may involve searching several tables and chasing several pointers. C programs have the branches and jumps hard-coded during linking so the CPU can't intervene to speed up the process.
- The Java specification explicitly identifies thread synchronization in the instruction stream. This means that picoJava chips can support synchronization primitives in hardware. In contrast, C programs that are running on a RISC chip carry out thread synchronization only through additional layers of software.

SOMETHING MISSING?

Complete your BYTE collection by ordering Back Issues today!

	1991	1992	1993	1994	1995	1996
January						
February						
March						
April						
May						
June						
July						
August						
September						
October						
November						
December						

Rates (postage and handling included):

Holland Df1 20.00, Switzerland SwFr 16.00, United Kingdom £ 7.75, France FFr 59.00, Germany DM 18.00, Sweden SEK 80.00 Only currencies mentioned above will be accepted. Other orders need to use credit card. Please indicate which issues you would like by checking (1) the boxes. Send requests with payment to:



Back Issues, c/o Dynamic Graphics International P.O. Box 25, 3950 AA Maarn The Netherlands

Check enclose	d	Charge:		First Name		
MasterCard	Eurocard	American Express	VISA	Last Name		
Card #				Address		
Exp. Date				Address		
Name				Postcode	City	
Signature				Country		
						\$2

Only credit cards or Eurochecks accepted! Please allow three weeks for delivery by surface mail.

A Division of The McGraw-Hill Companies

Running C in a Java World

The picoJava design team knew it had to overcome one major hurdle: the Java language has no instructions for manipulating a computer's main memory. Most computers use memory locations to handle all input and output. For example, getting input from a mouse or a keyboard requires reading directly from memory. For security and safety reasons, Java won't allow this, which is why many system designers believe Java is unusable as a general system language.

But picoJava designers had a trick up their sleeves. They simply added new byte-code instructions for reading and writing memory. These instructions won't work on a Java-ready browser, but they will work for Java chips. Someone could even write an entire OS in Java. You also could compile C for Java-only chips and convert memory references. In fact, C is similar enough to Java that a Java chip running C might be faster than a C chip emulating Java.

Are You a Prudent Person?

Then invest in DTK networking solutions with Pentium® Proprocessors!



Here's what Computer Reseller News, the industry's bible, said about DTK's APRI-31 network workstation with the Intel Pentium® Pro processor: "H-P, DTK lead the Pentium® Pro pack"

"The APRI's all-SCSI peripherals, AMI BIOS, Intel 440FX chipset and proprietary motherboard combined to garner the highest overall score and to outpace the field in two of the five applications tests. It finished...a close second in the remaining three individual tests." "The DTK APRI-31M/P200 is a price/performance leader, and an excellent value..."

— CRN, 9/2/96

Now, DTK's APRI-32 has **DUAL** Pentium® Pro processors!

The ultimate system for workstations and servers, it's DTK's new APRI-32, with dual Intel® Pentium® Pro 200MHz processors and an integrated Wide SCSI controller! The power of the new Windows® NT Workstation ver. 4.0 (shipped with the APRI-32) and DTK's new dual processor system make an ideal networking combination.



PENTIUM-PRO

Your new APRI-32 can be custom-configured with up to 384MB of EDO DRAM and a 3D or 2D PCI graphics card.

And, with the Seagate Wide SCSI hard drive with 2, 4 or 9 gigabyte capacity (2GB

is standard), the APRI-32 is an unbeatable workstation/server system.

All DTK systems are FCC-certified and UL-Listed. Technical support from our networksavvy specialists is free. DTK has combined the most advanced technology with sensible pricing. It doesn't take a Wall Street analyst to recognize that the APRI-32 is a wise choice!

APRI-32

- DUAL Intel 200MHz Pentium
 Proprocessors w/256KB internal cache
- Up to 384MB EDO RAM on board
- 3COM Network Card
- AMI Flash BIOS
- . 6X SCSI CD-ROM drive
- 2GB/4GB/9GB SCSI-2 or Wide SCSI Seagate Hard Drive
- PCI 64-bit Graphics Accelerator with 2MB or 4MB RAM
- · 3.5-inch Floppy Disk Drive
- . MS Mouse and MS Keyboard
- MS Windows NT Workstation v. 4.0
- · 2-Yr. Ltd. Warranty (On Site Option)

DTK Computer

Nationwide (800) 289-2385 ♦ See us at COMDEX - Booth S-3538

The Intel Inside Logo and Pentium are registered trademarks and the Pentium Processor Logo and the Pentium Processor Pro Logo are trademarks of Intel Corporation. All other trademarks are the properties of their respective owners.

©1996 DTK Computer Inc.

connect real-time data-acquisition instrumentation to the Internet to distribute information quickly to widely dispersed groups of clients.

However, Nicol says the Java language specifications leave him cool in terms of performance for real-time process control and data acquisition. "The design doesn't seem as elegant as it could have been. There's a strong software orientation," he says. "But Java does have business momentum behind it."

Economics also enters the picture. ARM, Intel, and Mips sell their chips for a wide range of applications, so they can justify spending more engineering time on their core engines. This could lead to a tighter performance race between general-purpose CPUs with JIT compilers and picoJava chips. Another hurdle for Sun could be unforeseen problems integrating picoJava chips into systems.

In the end, the success of Java chips will depend largely on the success of Java. An advantage for Java chip proponents is how complex it is to design a chip for fast C and Java code performance. CPUs that run C well may do a good job of emulating the Java VM, but they may never approach the speed of a chip optimized for Java code. The reverse is also true. To compensate, designers need more than a thorough understanding of CPU

WHERE TO FIND

Sun Microsystems Mountain View, CA (415) 960-1300 http:\\www.sun.com\sparc\

design; they need expertise in compilers and overall system architecture as well. But a one-size-fits-all approach to CPU design—with the right mix of software and hardware to wring out performance for two different platforms—probably won't satisfy end users if Java applications become ubiquitous.

If Java's platform independence and security features lead developers to embrace the language, users may be perfectly happy with Java-specific systems. But if native-code applications continue to dominate the market, specialized Java chips may be of interest only in the world of low-power embedded devices.

BYTE consulting editor Peter Wayner lives in Baltimore, You can reach him at pcw@access. digex.net.



ISDN Adapters: The Best for Business VDOLive: Video over Press Your Own CDs

Global

Act Now

ELECTRIC MONEY Send me 12 issues for \$45 (USD) air mail delivery. Save Time! Fax to: 1 353 91 752793

My payment is enclosed

Charge my: Visa Access/Eurocard/Mastercard

American Express

Card No. Signature

Name

Address

Exp. Date ___

email Address _

City/Postal Code

Please allow 8-10 weeks for delivery. If you pay with your credit card, you will be billed in your local currency (excluding Amex) A Publication of The McGraw-Hill Companies. Offer expires 6/30/97.



Remote Access Servers That Won't Ouit

- Power Clusters - Storage Breakthroughs

> Readers' Choice Awards Special Report: NT Everywhere Best Web Site Builder-Microsoft or Netscape?



12 Ways to Store Hundreds of Gigabytes of Data



Thinnest, Brightest ThinkPad Microsoft Powers Up SQL Server 6.5 Netscape Navigator 3.0: All but the Kitchen Sink

Run Your Business on the Web



Integrating ATM

Technica

Act Now and

Send me 12 issues for \$45 (USD) air mail delivery.

Save Time! Fax to: 1 353 91 752793

My payment is enclosed

Charge my: Visa

Access/Eurocard/Mastercard

Card No.

Signature

City/Postal Code

email Address

Please allow 8-10 weeks for delivery. If you pay with your credit card,

you will be billed in your local currency (excluding Amex) A Publication of The McGraw-Hill Companies. Offer expires 6/30/97.

FONR206

Country

Authority

Act Now

Send me 12 issues for \$45 (USD) air mail delivery.

Save Time! Fax to: 1 353 91 752793

My payment is enclosed

Charge my: Visa

Access/Eurocard/Mastercard

American Express

Card No.

Signature

Name

Address

City/Postal Code

email Address . Please allow 8-10 weeks for delivery. If you pay with your credit card,

you will be billed in your local currency (excluding Amex) A Publication of The McGraw-Hill Companies. Offer expires 6/30/97. FONR206



Visit BYTE on the Web http://www.byte.com

PLACE STAMP HERE

Act now to save, and

never

miss an issue!

RUTTE

The
Global
Authority
for Computing
Technology

BYTE

P.O. Box 72 Galway IRELAND

Visit BYTE on the Web http://www.byte.com

PLACE STAMP HERE

BYTE

P.O. Box 72 Galway IRELAND

Visit BYTE on the Web - http://www.byte.com

PLACE STAMP HERE



P.O. Box 72 Galway IRELAND

State of the Art

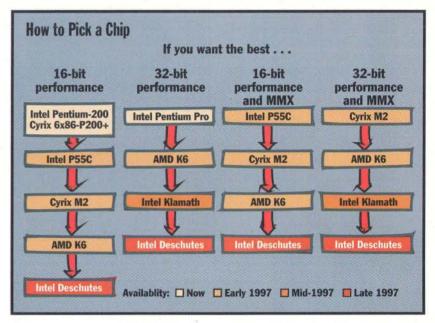
PC buyers face tough choices in 1997 as x86-chip vendors race to maintain their dominance. By Tom R. Halfhill

The x86 Gets Faster with Age

all it the year of megahurts. Rarely have PC users shopping for a new system faced so many microprocessor-induced headaches. And it won't end in 1997; hotter competition, architectural transitions, and software factors will probably make users' decisions difficult for the next few years. Hibernation is not an option.

While novices continue to blindly compare megahertz and megabytes, knowledgeable users will be juggling many more variables. These are outlined below.

- Intel's fastest Pentium is cruising at 200 MHz this fall, but due to inherent limitations of its aging architecture, it's barely faster than a Pentium-166. Also, the current P54C-series Pentiums don't recognize Intel's new MMX multimedia instructions. Early next year, Intel will address these problems by introducing the new P55C-series Pentiums. But the P55C is still a fifth-generation x86 processor that will appear at a crucial juncture when Intel is attempting to push the mainstream market toward the sixth-generation Pentium Pro.
- Lower prices and new system chip sets are making Pentium Pro-based desktop PCs more affordable. Unfortunately, the Pentium Pro isn't the best choice if you're running 16-bit software, including Windows 95. Also, current Pentium Pros do not support MMX. Intel is readying a new P6-class processor, code-named Klamath, that improves 16-bit performance and supports MMX. But you'll have to wait for it until mid-1997 at the earliest, and the upgrade path for Pentium Pro users is muddy.
- Cyrix's rejuvenated 6x86 handily beats a comparable Pentium, has no trouble with 16-bit code, and boasts the fastest I/O bus in the business. However, Cyrix can't match Intel's fastest core speeds, and the 6x86 doesn't support MMX. In addition, BYTE recently discovered that some revisions of the 6x86 suffer from se-



Are you confused by all the different x86 chips that are coming soon? Here's how to find your way through the maze.

rious performance problems when running on Windows NT Workstation 4.0.

- Cyrix plans to address all these issues early next year with an improved version of the 6x86, called the M2. But its MMX compatibility will be in question at first because Cyrix doesn't have a licensing agreement for the Intel technology.
- AMD, still struggling with its disappointing K5 series, will finally ship a version that lives up to the company's early promises. But the K5 is hopelessly far behind the leading edge. In 1997, AMD's hopes will ride on the K6, which is supposed to support MMX and match or exceed the performance of the Pentium Pro. After stumbling with the K5, AMD desperately needs to win back the confidence of system vendors and users.
- A new contender, International Meta Systems (IMS), claims that it will introduce a CPU that fits into Pentium sockets and approximates the performance of a Pentium Pro. IMS has made previous attempts to break into the x86 market, but

- those products never shipped. This time, IMS is taking a different approach (see the text box "IMS Rides Again with the Meta-6000" on page 90).
- Looming on the horizon is Intel's seventh-generation x86, known as the P7 or Merced. It will introduce a 64-bit x86 architecture. However, systems built with this chip probably will not appear until 1998 at the earliest, so the Merced should not affect your near-term plans.

Intel's Introductions

To defend its high profit margins and to keep its huge wafer-fabrication plants busy, Intel must periodically abandon an older-generation CPU and steer the market toward the next-generation product. That's what will happen to the Pentium in 1997. Although the Pentium will remain a high-volume product next year, Intel wants users to start thinking of the Pentium Pro as a mainstream CPU. Until now, Intel has mainly positioned the Pentium Pro for servers and workstations.

continued

However, this predictable transition (which happens about every four years) is a little more confusing this time because Intel is simultaneously introducing MMX, an architectural enhancement that spans both generations (see "x86 Enters the Multimedia Era," July BYTE). Because MMX will debut with the Pentium, not the Pentium Pro, users who buy new systems during the transitional phase will have to wrestle with a few more decisions.

MMX will appear first in the P55C-series Pentiums, which are scheduled to begin shipping in the first quarter of 1997. They have improved pipelines and twice as much on-board cache: 16 KB each for the primary instruction and data caches, compared to the 8-KB caches in previous Pentiums. As a result, the P55C will outperform a regular Pentium at the same clock speed, even without MMX acceleration. Sources estimate the performance gain to be about 15 percent—an important point if you're comparing two systems with different Pentiums.

The P55C will likely debut at 200 MHz, but it may run as fast as 233 MHz. Unfortunately, upgrading to a P55C probably won't be as simple as plugging the chip into an existing Pentium socket. Although it's pin-compatible with existing sockets, Intel had to reduce the voltage so that the chip runs cool enough at higher clock speeds. Thus, you'll probably need a new motherboard for the P55C.

Waiting for Klamath

Astute users who want to postpone obsolescence are looking toward the next generation: the Pentium Pro. Unfortunately, this chip has several problems. It bogs down under 16-bit software and won't support MMX until after the P55C. It's also expensive, because it uses a multichip module to incorporate a 256- or 512-KB Level 2 (L2) cache in the same package with the CPU die. And it requires more costly system chip sets and six-layer motherboards.

Intel's solutions are the Klamath and new chip sets. Intel isn't talking about Klamath yet, but this P6-class chip will almost certainly eliminate the expensive multichip module. Intel will reportedly offer the Klamath on a small daughtercard that plugs into a special slot on the motherboard. The daughtercard would include the CPU and the L2 cache, and some daughtercards may have sockets for multiple CPUs.

IMS Rides Again With The Meta6000

Only two companies besides Intel make leading-edge x86 processors: AMD and Cyrix. International Meta Systems (IMS), a small company known for rogue CPU designs, thinks there's room for a third.

IMS claims it will introduce an x86 chip in late 1997 that fits into Pentium sockets and delivers P6-level performance. The CPU will adopt most of the techniques used by other fifth- and sixth-generation x86 processors, including deep pipelines, branch prediction, speculative execution, out-of-order execution, scoreboarding, and rename registers. It will also recognize Intel's MMX multimedia instructions. Unlike Intel's chips, however, it will support concurrent floating-point (FP) processing by internally shadowing the FP registers instead of reusing them.

It's difficult to judge the reliability of these claims. IMS has produced some languagespecific processors (for Smalltalk and FOR-TRAN) and is also working on a Java chip. But until now, the company has never competed against the big boys with an x86. In 1992, IMS announced the 3250, a unique RISC chip with rewritable microcode that could emulate an Intel 486 or a Motorola 68000. That chip never came out, although there were rumors that IMS licensed the technology to other companies.

Is the Meta6000 another vaporchip? Could be, but don't forget the NexGen story. NexGen labored for eight years before shipping the Nx586 in 1994. And although the Nx586 never became popular, it was a respectable design that beat AMD's and Cyrix's fifth-generation CPUs to market. Last year, AMD bought NexGen to obtain the sixth-generation Nx686, now called the K6. So don't diss IMS.

Getting rid of the multichip module would drastically reduce Intel's manufacturing costs. It would also make it easier to upgrade a system, because users could swap daughtercards to get a faster CPU, more cache, or both. That's why Apple started using CPU daughtercards in its high-end Power Macs last year.

But separating Klamath's CPU and L2 cache could have some less desirable side effects as well. First, there's the question of performance. The Pentium Pro's L2 cache is closely coupled to the CPU over a dedicated 64-bit bus that runs at the same clock speed as the core. It's an extraordinarily fast bus that contributes a lot to the Pentium Pro's superior 32-bit benchmark results. Moving the L2 cache out of the package may force Intel to adopt a slower bus. If so, Klamath would need a larger cache, higher clock speeds, and perhaps some additional enhancements to compensate for the loss. If Intel puts Klamath on a daughtercard, the bus that connects this card to the motherboard is another potential bottleneck.

Faster Clocks

In any case, Klamath will support MMX and probably include some modifications to enhance 16-bit performance. Higher clock speeds are a certainty, thanks to Intel's new 0.28- and 0.25-micron CMOS processes. In 1997, these smaller processes will supersede the 0.35-micron BiCMOS process on which today's Pentiums and Pentium Pros are built.

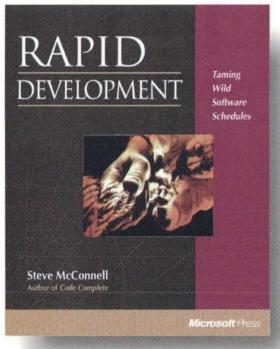
Klamath will debut sometime in 1997 at 0.28 micron, yielding a minimum clock speed of 200 or 233 MHz, going perhaps as high as 266 MHz. Later in the year, Intel will phase in the 0.25-micron CMOS process. This will lead to a P6-class chip (code-named Deschutes) that should hit 300 or 333 MHz.

That'll be great for new buyers, but where does it leave the early adopters of the Pentium Pro? If Intel, as expected, discards the multichip module, Klamath almost certainly won't be compatible with existing 387-pin Pentium Pro sockets. Moving the L2 cache outside the package onto an external 64-bit bus would require 72 more pins. The only alternative would be to interface the L2 cache to the front-side I/O bus, but that would seriously impair performance.

The bottom line: If Intel segregates the L2 cache, existing Pentium Pro systems probably won't be upgradable to Klamath. The new chip wouldn't fit the old sockets, and the old motherboards don't have a daughtercard slot. Intel has longrange plans for Pentium Pro OverDrive chips, but they probably won't appear before 1998. Pentium Pro users will end up swapping motherboards or buying a whole new system.

On the bright side, those new motherboards and systems will cost less. New system chip sets from Intel and Silicon Integrated Systems (SiS) are slashing the cost of building a Pentium Pro system. For example, Intel's new 440FX chip set has

Finish faster.



Rapid Development ISBN 1-55615-900-5

\$35.00 (\$46.95 Canada)

"An indispensable road map for those who wish to write code as fast as humanly possible..."

— G. Pascal Zachary, author of SHOWSTOPPER!: The Breakneck Race to Create Windows NT and the Next Generation at Microsoft

In RAPID DEVELOPMENT, award-winning author Steve McConnell reveals the secrets to taming wild software schedules. He analyzes the development-speed implications of many traditional development practices, pointing out which are effective and which are harmful. The book alerts you to 36 classic mistakes—practices intended to shorten the development process that lengthen it instead. McConnell counters with 27 proven ways to shorten schedules and reduce the risk of schedule overruns. RAPID DEVELOPMENT has a hardheaded, practical focus—with the emphasis on suggestions you can use right away to finish your next development project faster.

Microsoft*Press



only three parts and costs less than half as much (\$94) as the eight-part 450KX chip set found on many of today's Pentium Pro motherboards. And SiS offers a one-chip solution, called Archer, that costs only about half as much (\$39) as the 440FX. Moreover, these solutions work with four-layer motherboards instead of the six-layer boards required by the 450KX. Although they sacrifice a few features—such as memory expandability and multiprocessor support—these compromises are reasonable for desktop systems priced in the \$2000-to-\$3000 range.

Merced Mania

Further out is Intel's seventh-generation x86, the mysterious P7/Merced. Merced will extend the 32-bit x86 architecture to 64 bits and introduce a new instruction set. This architecture, dubbed IA-64, will be backward compatible with the existing x86 architecture, just as the 32-bit architecture of the 386 was compatible with the 16-bit 286, 8086, and 8088.

Although Merced is the fruit of Intel's partnership with Hewlett-Packard, it's looking less likely that IA-64 will radically depart from today's x86 architecture by adopting very-long-instruction-word (VLIW) technology. Intel will probably take a more conservative approach by extending the microarchitecture of the Pentium Pro. Pure VLIW is the antithesis of Intel's current design track; the Pentium Pro optimizes the instruction stream during execution, while a true VLIW processor would shift that responsibility to the compiler at design time.

There's still plenty of performance to be gained by extending the Pentium Pro's "dynamic execution" core. Intel could expand the reorder buffer, tweak the reordering algorithms, improve the branch prediction, add more execution units, boost the Level 1 (L1) caches (which are relatively small), and make other general improvements that would legitimately represent a seventh-generation design.

If VLIW plays any role at all, perhaps Intel and HP have found a way to adapt some tenets of that philosophy to the x86, just as Intel has integrated some elements of RISC into the Pentium Pro. Or maybe a full-blown VLIW design will appear in a subsequent processor.

Intel's alliance with HP also calls for Merced to run PA-RISC software. Some observers think this trick will require emulation, in either software or hardware. It would be useful to run PC applications on an HP workstation, but it's doubtful that the ability to run PA-RISC software on PCs would win significant additional market share for Intel.

In any event, Intel is committed to a 64-bit CPU that runs 16- and 32-bit x86 software without emulation. Native IA-64 programs will run faster than 16- or 32-bit programs, but nobody—possibly not even Intel—knows exactly how much faster.

Another unknown is how quickly the industry will adopt IA-64. Remember, it's been 11 years since Intel went 32-bit with the 386 in 1985, and most PC users are only now migrating to 32 bits. Microsoft didn't ship a 32-bit OS until 1993, and the

vast majority of PC users still use 16-bit Windows 3.1 or 16-/32-bit Win 95. Although Microsoft recently dropped some vague hints about a 64-bit Windows NT, the first 64-bit OS for Merced will probably be Summit 3D, a new flavor of Unix currently under development by HP and The Santa Cruz Operation (SCO). If the 64-bit transition follows the same course as the 32-bit transition, then IA-64 won't be a significant market force until the year 2009.

Cyrix Crystal Ball

After a shaky start with the 6x86, Cyrix is finally gaining on Intel's price/performance lead. The first 0.6-micron version of the 6x86 suffered from a huge die. Cyrix switched to a process with five layers of metal instead of three, shrinking the die from 394 square millimeters to 210 mm². During the summer, Cyrix moved to a 0.5-micron process, achieving a die size of 170 mm².

Like an overweight athlete shedding excess fat, the 6x86 chip now runs a lot faster: 150 MHz instead of 100 MHz. And thanks to a more efficient microarchitecture, the 6x86 easily outruns a Pentium at the same clock speed. In fact, the 150-MHz 6x86 chip slightly outperforms a 200-MHz Pentium, which is why Cyrix designates this chip the 6x86-P200+ in accordance with the P-rating benchmark (see the text box "The Problem with P-Ratings" on page 94).

Recently, however, BYTE discovered that some 6x86-based systems have a serious problem with the final-release can-

Who's Who in x86

Here's what to expect from x86 vendors over the next year. (Note: Performance estimates and ship dates are BYTE's assumptions based on preliminary information from vendors.)

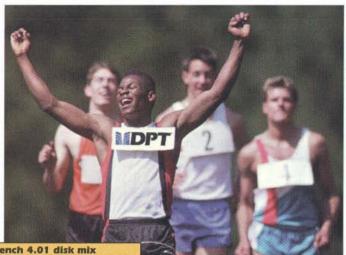
Company	СРИ	x86 generation	MMX	Availability	Comments
AMD	K5	Fifth	No	Now	Latest versions have significantly increased performance.
AMD	K6	Sixth	Yes	March 1997	Redesigned NexGen Nx686.
Cyrix	Gx86	Fifth	No	Now	Highly integrated chip for low-cost PCs.
Cyrix	6x86	Sixth	No	Q1 1997	75-MHz I/O bus is the fastest on any x86 chip.
Cyrix	M2	Sixth	Yes	Q1 1997	Improved version of 6x86; MMX compatibility a challenge
IMS	Meta6000	Sixth	Yes	Late 1997	Company has uncertain track record.
Intel	P54C Pentium	Fifth	No	Now	Dominates market; fastest speed is 200 MHz.
Intel	P55C Pentium	Fifth	Yes	Q1 1997	Slightly faster than P54C Pentium.
Intel	Pentium Pro	Sixth	No	Now	L2 cache in multichip module; poor 16-bit performance.
Intel	Klamath	Sixth	Yes	Mid-1997 (?)	Improved Pentium Pro; L2 cache probably separate.
Intel	Deschutes	Sixth	Yes	Late 1997	Improved Pentium Pro; should reach 300 MHz.
Intel	P7/Merced	Seventh	Yes	1998-1999 (?)	Highly secretive joint project with Hewlett-Packard.

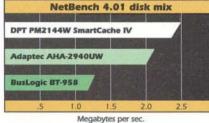
SMARTCACHEV



"Our competitors are solidly behind us."

20-50% behind us, to be exact.





- PCI, EISA and ISA
- · Upgradable to hardware RAID and caching
- · Bus-mastering with on-board processor
- · Support for all major operating systems
- New: Ultra SCSI models now available

This chart from the May, 1996 issue of **PC Magazine** (UK) shows the results described in their review of SCSI adapters entitled "Survival of the Fastest". According to PC Magazine, "SmartCache IV was demonstrably quicker than the other two [boards tested]."

(Adaptec 2940UW and BusLogic BT-958).

Here's your chance to get ahead of the competition. Call for more information about SmartCache IV SCSI adapters and modules. You'll see why we say: SmartCache, Smart Choice!



1-800-860-4589

















Circle 140 on Inquiry Card.

didate of Windows NT Workstation 4.0. We ran 32-bit Windows applications tests on a 6x86-P200+ system and then compared the results to those obtained on the same system with a beta version of NT 4.0. To our surprise, the tests ran about 25 percent slower on the release candidate of NT 4.0. The 6x86 also ran NT 4.0 about 16 percent slower than NT 3.51 and 24 percent slower than Win 95. In similar tests with Pentium-based PCs, performance improved on the release candidate of NT 4.0.

This problem might be related to some last-minute code that Microsoft added to NT to make it more stable on Cyrix-based PCs. Check The BYTE Site (http://www.byte.com) for the latest updates on this developing story.

Another upcoming challenge for the 6x86 is MMX. Cyrix was working on its own multimedia extensions when Intel unveiled MMX and announced a crosslicensing agreement with AMD. Cyrix doesn't have such a deal, but it promises that the next version of the 6x86—codenamed M2—will be MMX compatible.

The M2 is scheduled to start sampling in the fourth quarter of this year and then begin volume production during the first quarter of 1997. That means the M2 will be committed to silicon before Cyrix's engineers can get a close look at the P55C. To support MMX, they will have to rely on publicly available technical data from Intel—and perhaps some Texas windage as well.

Cyrix says that it has indirect access to some Intel technology through its fab partners, IBM Microelectronics and SGS Thomson, which have licensing agreements with Intel. Cyrix also notes that it has a good track record of x86 compatibility. Even so, MMX will be a question mark until independent parties get a chance to thoroughly test the M2.

Klamath Competition

The M2 will also move to a 0.35-micron process and beef up its unified L1 cache to an impressive 64 KB. M2 clock speeds will be 180 MHz and 200 MHz at introduction, with 225 MHz coming later in 1997. In combination with other improvements, those clock rates should allow the M2 to beat a P55C and compete strongly against Klamath.

Cyrix's biggest contribution to the PC industry might be a kick in the pants toward 75-MHz I/O buses. The 6x86-P200+

The Problem with P-Ratings

AMD and Cyrix will soon face a dilemma: How can they compare the performance of their processors to that of Intel's when the baseline keeps changing?

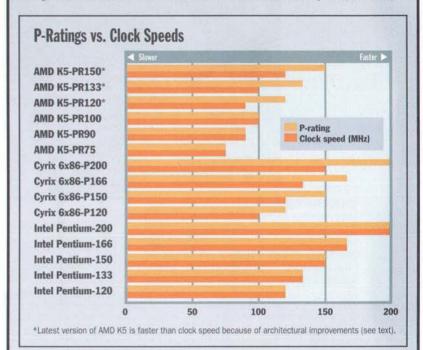
Until recently, users could judge the relative performance of two different x86 chips of the same generation by comparing clock speeds. CPU cores from AMD, Cyrix, and Intel were similar enough that performance didn't vary much—a 33-MHz 486 from one vendor was as fast as a 33-MHz 486 from a competitor.

But as the x86 moves through its fifth and sixth generations, microarchitectures are

standardize on Performance Ratings, abbreviated as *P-ratings* by Cyrix and as *PR-ratings* by AMD.

MicroDesign Resources, which publishes the Microprocessor Report, acts as the independent testing lab. Cyrix's 150-MHz 6x86 is labeled the 6x86-P200+ because it matches or exceeds the performance of a Pentium-200; AMD's new 100-MHz K5 is called the K5-PR133 because it's comparable to a Pentium-133.

But P-ratings use today's Pentium as the baseline. When Intel introduces the P55C Pentiums in 1997, they're expected to per-



An x86-compatible chip rated at P-120 delivers performance comparable to that of a 120-MHz Pentium.

diverging to the point where clock speeds are no longer valid, even for shorthand comparisons. For instance, Cyrix's 150-MHz 6x86 outruns a 200-MHz Pentium.

Industry-standard benchmarks, such as SPEC95, are one answer, as are magazine benchmarks, such as the BYTEmark and WinBench. But these tests typically yield measurements that don't directly compare different CPUs. (BYTEmarks are normalized to a Pentium-90 baseline, not relative clock speeds, although you could figure it out by doing a little math.)

AMD and Cyrix prefer numbers that users can compare directly to Intel clock speeds. That's why they joined forces last year to form about 15 percent better than a regular Pentium at the same clock speed. Users might be confused: Which Pentium does the P-rating refer to?

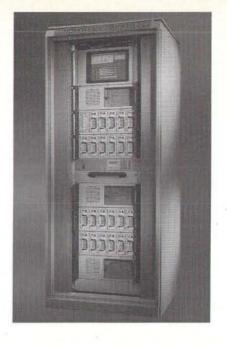
Then there's the Pentium Pro. Comparisons to Intel's flagship CPU will require yet another variation of the P-rating.

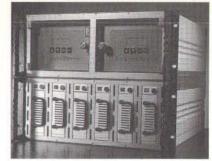
Cyrix and AMD claim they're working on a solution. But knowledgeable buyers don't rely exclusively on vendors' performance claims, anyway. By collecting benchmark data from multiple sources—including the popular magazine benchmarks, which are freely available—expert users can reach their own conclusions, even if it takes a little more effort.



Novotec 19" RAID System

- 8 U-chassis
- modular expandable
- 2 redundant power supplies (600 W)
- maximum ventilation of all built-in components
- fast-SCSI and wide-SCSI cabling according to your requirements
- drive shuttles with hot-swapping





Novotec 19" Cluster

- 8 U-chassis
- modular expandable
- 2 redundant power supplies (600 W)
- maximum ventilation of all built-in components
- drive shuttles with hot-swapping
- flexibility by the use of 1-6 wide-SCSIchannels

19"-technology? Cases and server – solutions from NOVOTEC COMPUTERS

NOVOTEC COMPUTERS combines innovative technology, reliability and quality to an overall picture of high performance servers and fault tolerant disk-arrays. Highest quality and the use of modern technologies pay: the cases and systems from NOVOTEC COMPUTERS set standards. The flexible system concept allows full scope for expansions and therefore protects your previous investments.

NOVOTEC COMPUTERS uses only high-performance components from leading producers and thereby guarantees an open industry standard. The development, production and final checks are performed according to the regulations of the Standard ISO 9001.

Modular design, flexibility and special application solutions are the characteristics of the products of NOVOTEC COMPUTERS. Included are PC systems as well as complete network solutions, from concept to implementation.

Decisive advantages of clustering:

- no down-time at breakdown of one controller or host
- increased performance by multiple-host-use



Innovative technologies, quality and reliability by NOVOTEC COMPUTERS









CE

NOVOTEC Computers Ingolstädter Straße 12 80807 Munich (Germany) Phone: +49/89/35 62 97-0 Fax: +49/89/35 62 97-70 Mailbox: +49/89/35 65 15 33 http://www.novotec.com



runs its core at 150 MHz and the I/O bus at an unprecedented 75 MHz. Until now, the fastest x86 buses topped out at 66 MHz. That 14 percent improvement provides a significant boost for I/O-intensive servers.

Unfortunately, systems designers have trouble making 75-MHz motherboards, which is why nobody has done it until now. Only one system chip set (from VLSI Technology) currently supports the 75-MHz bus. Without that chip set, the 6x86-P200+ has to synchronize its bus at 50 MHz, which bleeds so much performance that the chip no longer merits the P200+ designation. Maybe that's why Cyrix entered the systems business last summer; if you want to get a 6x86-P200+ system with a 75-MHz bus, you can buy one directly from Cyrix.

Cyrix is also working on an 83-MHz bus. That's nearly 26 percent faster than 66 MHz and would certainly provoke server envy among rival vendors. Until chip-set makers and motherboard manufacturers catch up, however, these bus speeds are mainly a technical curiosity. It

will probably require the weight of Intel to shove the industry forward, and Intel hasn't publicly committed itself to speedier buses.

In another interesting move, Cyrix is introducing a highly integrated chip that would allow consumer PCs to retail for \$800. Tentatively called the Gx86, the new processor is based on a low-cost chip that Cyrix announced last year for notebook computers. If the \$800 consumer PCs succeed, Cyrix hopes to design a version for corporate intranets. Cyrix would position that chip as a CPU for low-cost, Windows-compatible network computers. (See the text box "Cyrix Gx86 for Dirt-Cheap PCs" at right.)

AMD Road Map

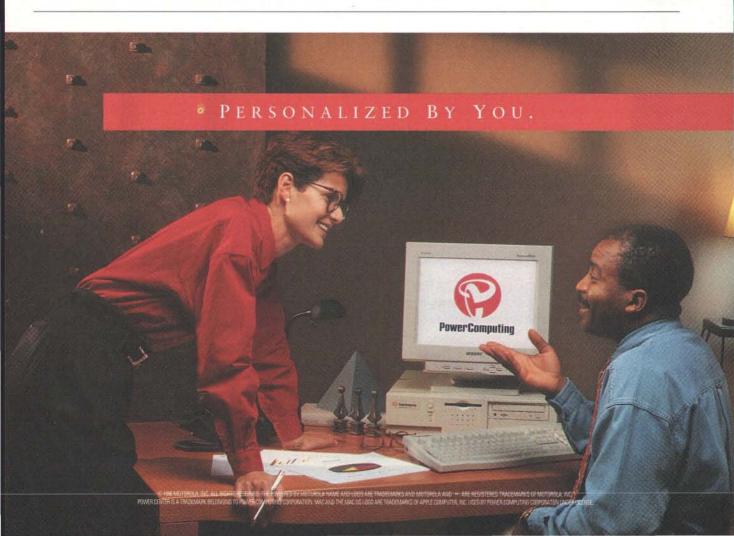
Sometimes a design that looks great on paper falls flat in the real world. AMD's ordeal with the K5 wasn't quite as embarrassing as the baggage-handling debacle at Denver's new airport, but it was bad enough. The K5 was supposed to bring AMD's chips within striking distance of Intel's top CPUs; instead, numerous prob-

lems have kept the K5 from seriously challenging even the Pentium, much less the Pentium Pro.

Despite the conventional wisdom that PC prices go nowhere but down, entry-level computers have been stuck in the \$1200-to-\$1500 range for a decade and have actually doubled in price since the early 1980s. Now that IBM, Oracle, Sun Microsystems, and others are promoting economical network computers, some PC vendors are exploring ways to make sub-\$1000 systems without sacrificing Windows compatibility.

Intel is taking a wait-and-see attitude. Cyrix, however, is jumping in with the Gx86, a highly integrated, low-cost PC-on-a-chip that allows a full-featured system to sell for about \$800. Buyers would get a PC with Pentium-120 or Pentium-133 performance, 16 MB of RAM, a hard disk, a six-speed CD-ROM drive, a modem, and input devices.

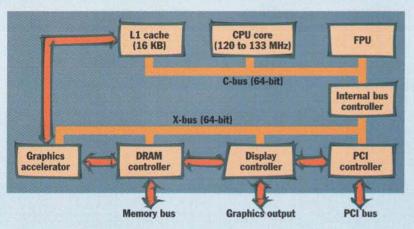
To make this possible, the Gx86 integrates several functions that normally require extra



Now the K5 is back on track. It's too late for the chip to gain the leading edge, but it can still compete against the Pentium for desktop PCs costing under \$2000. Currently, AMD is shipping the K5 at three speeds: 75, 90, and 100 MHz. They close-

ly match Pentium performance at equivalent clock rates, earning them P-ratings of PR75, PR90, and PR100, respectively.

Cyrix Gx86 for Dirt-Cheap PCs



The Gx86 integrates components that normally need separate chips and eliminates the frame buffer and Level 2 cache.

chips. It has built-in SVGA graphics, a PCI interface, and 16-bit Sound Blaster emulation. It also has a unified memory architecture (UMA), which buffers the screen data in main memory instead of in a separate frame buffer. UMA can degrade performance, but Cyrix says the Gx86 avoids this by integrating the video logic with the CPU.

The CPU core is a stripped-down version of the Cyrix 6x86. It sacrifices superscalar pipelines and speculative execution but still predicts branches and retains a 16-KB cache. Although the Gx86 probably would not do as well as a Pentium-120 or Pentium-133 when running a CPU-level benchmark, Cyrix claims the efficiencies of high integration allow the chip to deliver that level of overall system performance. (BYTE has not yet tested these claims.)

Cyrix expects to introduce the chip by the end of this year and says that several "top-tier" system vendors will ship Gx86-based PCs in early 1997.

POWERED BY MOTOROLA.



People take their computers personally. Which is why every award-winning PowerCenter™ Mac OS™ system from Power Computing is

designed to be customized by its end user. Priced under \$2K, these high-performance systems can be configured in an infinite number of ways.

Yet, every one of them attains its speed and power from an identical source. Motorola PowerPC 604™ RISC microprocessors are the oomph! that help PowerCenter

computers live up to their name. From custom-configured computers to reloadable stored-value cards, Motorola powers innovative solutions that enable your success.

Visit us at http://www.motorola-powered.com/ or call 1-800-521-6274 (Ref. #996).



The next versions of the K5—which are scheduled to ship in September or October—are supposed to live up to the K5's original specifications, which called for 20 percent to 30 percent greater performance than a Pentium running at the same clock speed. The new chips run at 90 and 100 MHz but carry P-ratings of PR120 and PR133, respectively.

To attain these higher P-ratings, AMD's engineers tweaked the K5 chips's core in several ways. First, they optimized the K5's execution of certain x86 instructions (e.g., repeat MOVs and far CALLs) that occur more often in real-world software than AMD's simulations had predicted. Next, they added a small prefetch cache in front of the L1 instruction cache. This fixed a problem that arose when the K5's prefetch logic aborted a cache fill in order to follow a branch to a new target address; if the program later branched back to the original instruction stream, the K5 had to fill the cache all over again. The new prefetch cache temporarily holds the cache lines to prevent a slow memory transaction. Finally, AMD eliminated some internal bus bottlenecks.

According to AMD, the K5 now runs about 30 percent faster than an equivalently clocked Pentium. (BYTE has not yet confirmed these claims.) In November or December, AMD plans to start shipping a 120-MHz version of this core, which would yield an equivalent Pentium performance of PR150. Even faster cores may appear in 1997.

Pinning Hopes on the K6

With Intel ramping up the P55C, Pentium Pro, and Klamath, 150-MHz performance will keep AMD firmly stuck in the number-two spot—or at number three, behind Cyrix. Clearly, AMD's future hopes ride on its next-generation product, the still-evolving K6 processor.

Here, too, the road to glory has been rocky. As originally designed by NexGen, the K6 was supposed to have a dedicated bus for the L2 cache, an integrated L2 cache controller, and a new execution unit for multimedia instructions. It was also going to be manufactured by IBM Microelectronics, NexGen's fab partner.

When AMD acquired NexGen in late 1995, those plans abruptly changed.

For the past year, AMD engineers have been modifying the K6 to make it compatible with MMX. This could require some major changes. The original K6 included a special multimedia execution unit, while Intel's MMX instructions are integer operations designed to execute in the regular integer units. It's possible that AMD will replace the multimedia unit with another integer unit, which would improve the K6's performance with non-MMX code, too.

WHERE TO FIND

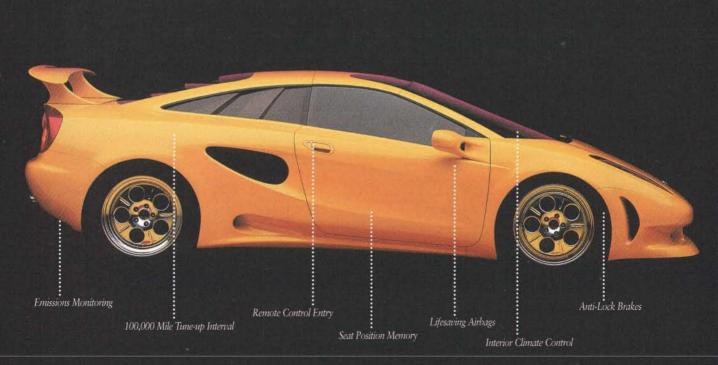
AMD Sunnyvale, CA (408) 732-2400 http://www.amd.com

Cyrix Richardson, TX (214) 968-8388 http://www.cyrix.com

Intel Santa Clara, CA (408) 765-8080 http://www.intel.com International Meta Systems El Segundo, CA (310) 524–9300 http://www.imes.com

Silicon Integrated Systems Sunnyvale, CA (408) 730-5600

FUELED BY INNOVATION



Another significant change is that the K6 will be pin-compatible with P54C-series Pentium sockets. The original Nx686 had a proprietary pin-out that required special system chip sets, a disadvantage that stunted the sales of NexGen's earlier Nx586 processor. Pin compatibility with Pentium sockets opens up a more lucrative market for the K6. Unfortunately, it also forces AMD to abandon the K6's high-speed L2 bus and integrated cache controller, because Pentium sockets don't support those features. To compensate, the K6's L1 caches now total 64 KB, compared to 32 KB for the Nx586.

Finally, engineers are reworking the K6 so that AMD can manufacture the chip at its new Fab 25 in Austin, Texas. The K6 will debut on AMD's 0.35-micron, five-layer-metal CMOS process, migrating later to 0.25 micron.

In an important move, AMD has licensed an advanced pad-bonding technology, called C4, from IBM Microelectronics. On most chips, the wires leading to the pins are soldered onto tiny pads crowded along the edges of the die. C4 technology allows circuit designers to distribute those pads anywhere on the die. This gives the designers more flexibility and also shortens the chip's critical paths, yielding higher performance. In addition, when the chip migrates to smaller processes, C4 prevents it from becoming "pad-limited"—AMD won't have to hold the die at a certain size just to leave room for the pads.

AMD says it will begin sampling the K6 late this year and start production in March. The K6 will debut at 180 MHz and support bus speeds as high as 75 MHz. AMD is sticking to NexGen's original performance estimates for the Nx686, claiming that it will be "competitive" with the Pentium Pro when running 32-bit software and considerably faster with 16-bit code. If AMD can deliver on those promises—admittedly, that's a big if—the K6 will help close the performance gap that widened when the K5 missed the target.

Look Before You Leap

In a transitional year like 1997, purchasing decisions will be more critical than

ever. It's not as simple as buying the fastest Pentium.

If multimedia matters, you should wait for MMX. If you want to get the best possible performance with 32-bit software, then wait for Klamath or even Deschutes. If you're running a great deal of 16-bit software (especially on Windows 3.1 or Win 95), wait to see how well Klamath and Deschutes address the Pentium Pro's 16-bit weaknesses—or consider getting a Cyrix or AMD chip. If you crave the fastest possible bus for an I/O-intensive server, the Cyrix 6x86-P200+ is the only game in town.

You can shop for bargains, too. There will be markdowns on regular Pentium systems after MMX appears and while Intel pushes the Pentium Pro as the next mainstream CPU. There's nothing wrong with buying a system that isn't top-of-the-line—as long as you know what you are getting.

Tom R. Halfbill is a BYTE senior editor based in San Mateo, California. You can reach him at thalfbill@bix.com.

POWERED BY MOTOROLA.

A vehicle doesn't start with a key. It starts with a dream. Ideas are the fuel that drive the world's number one industry, and Motorola is the chip supplier that automotive engineers specify most to power those dreams to reality. In fact, numerous semiconductors are among the standard equipment that help make vehicles today more safe, comfortable

and environmentally friendly. From automotive electronics to wireless communications, Motorola powers innovative solutions that enable your success.

Visit us at http://www.motorola-powered.com/ or call 1-800-521-6274 (Ref. #896).



Let Microway build your next Graphics Workstation, Web Server or Personal Supercomputer using...

Screamer 500

The fastest motherboard on the planet just got faster!

500 MHz, 1 Gigaflop

Since 1982 Microway has provided the PC world with the fastest numeric devices and software available. No product in the last 14 years has excited us more than the 500 MHz Alpha Screamer. With its ability to execute 2 billion operations per second, the Screamer is the best choice for your next workstation or server! In addition to NT, the Screamer runs Digital UNIX, OpenVMS and Linux. This means you can run many of your VAX and MOTIF applications on the same hardware that runs Microsoft Excel or Word, Oracle, Adobe Photoshop; plus engineering and graphics applications like Pro/ENGINEER, Microstation, AutoCAD, Softimage and Lightwave. Plus, Digital's FX!32 makes it possible to run 32-bit WIN95 and NT applications on the Alpha. Over the last fourteen years we have designed systems for thousands of satisfied customers including many prestigious institutions. Our technicians are expert at



System Performance

configuring the four Alpha operating systems we support.

Microway understands the importance of balancing a fast CPU with equally fast caches, memory and peripherals. To achieve balanced performance, the Screamer features the fastest cache/memory system in the

industry, employing 1 to 2 MB of 9 nsec burst SRAMs fed by a 288-bit wide memory system. Its 64-bit PCI bus is driven by a state-of-the-art Digital chip set that feeds 32- and 64-bit PCI sock-



ets. To take advantage of these resources, Microway installs the best graphics and hard disk controllers available, including controllers appropriate for 2 and 3D Graphics Workstations and RAID powered Servers.

Numeric Performance

Finally, we are experts at squeezing every drop of numeric performance out of the Alpha. Microway produces one of the finest numeric optimized compilers running on any platform - NDP Fortran. Since its introduction in 1986, hundreds of applications have been ported to the X86 with it, including well known industry standards like MATLAB and ASPEN. Our latest RISC scheduler has a number of features that make it easy to take advantage of the Alpha's quad-issue capability. Running on a 500 MHz 21164 that bursts at 1 gigaflop, a dot product kernel we use for compiler testing runs at a mind-boggling 844 megaflops!!! For a complete description of the optimization facilities provided by NDP Fortran or C++, our Screamer Systems and motherboards call 508-746-7341 or visit our WEB Site at: http://www.microway.com.

Digital, Alpha, OpenVMS and Digital UNIX TM Digital. NT, Excel and Word TM Microsoft. Screamer, NDP Fortran and Microway TM Microway.

Microway[®]

Technology You Can Count On

Corporate Headquarters: Research Park, Box 79, Kingston, MA 02364 USA • TEL 508-746-7341 • FAX 508-746-4678 www.microway.com, info@microway.com • France 33 146229988 • Germany 49 6997650001 • India 91 806637770 Italy 39 27490749 • Japan 81 64593113 • Korea 82 25981623 • Poland 48 22487172 • United Kingdom 44 1815415466

State of the Art

Stung by Intel's gains in processor performance, the PowerPC alliance will strike back with higher clock speeds and new chip designs. By Tom R. Halfhill

PowerPC Regroups

on't count your megahertz before they're hatched. That's what the PowerPC alliance has learned after prematurely gloating over the imagined obsolescence of Intel's x86.

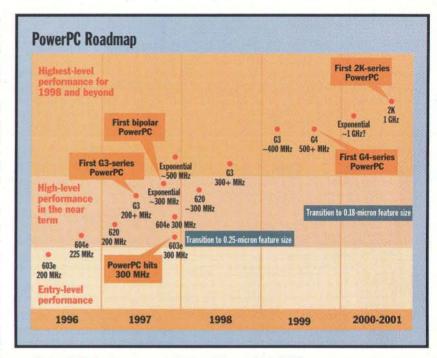
One famous advertisement from 1992 showed how CISC performance was falling flat while RISC technology soared toward the SPECint stratosphere. Another ad warned about the coming fate of x86-based PCs by picturing a highway running smack into a brick wall.

Somehow, things didn't work out that way. Intel's Pentium and Pentium Pro have not only managed to keep the 18year-old x86 architecture competitive: they have at times surpassed the performance of leading RISC chips, including the PowerPC. Apple fulfilled its promise to sell millions of Power Macs, but system-level limitations have foiled Apple's attempts to exploit the full potential of the PowerPC chips. IBM fumbled the introduction of its own PowerPC desktop systems and embarrassingly failed to port OS/2 to PowerPC. And four years after the PowerPC's birth, the alliance is only now finalizing the PowerPC Reference Platform for clone makers.

If the PowerPC is to retain any credibility as an alternative to the x86, the alliance must deliver a steady stream of faster chips and a viable system standard that attracts big-volume vendors. In 1997, Motorola and IBM will roll out faster versions of current PowerPC chips, introduce a new generation of 32- and 64-bit processors, accelerate the development of future CPUs, and oversee the debut of PowerPC Platform systems that can run the Mac OS, Windows NT, and Unix. With Intel running full speed toward 300-MHz Pentium Pros and the 64-bit Merced, 1997 could be the PowerPC's last shot at glory.

The Indy 300

One measure of the PowerPC's competitiveness will be its ability to break the



PowerPC designers need to achieve 300 MHz next year to stay in the performance race with the x86.

300-MHz barrier. Digital's exotic Alpha did it more than a year ago, but CPUs for mainstream desktop systems are only now creeping beyond 200 MHz. By the end of next year, we should see 300-MHz chips from Intel, IBM, Motorola, and probably Exponential Technology, a Silicon Valley startup that will ship the first PowerPC processor built with bipolar transistors (see "Exponential's Bid to Beat the Pack," page 104).

CPUs capable of attaining 300 MHz include Intel's Deschutes (a Pentium Pro variant), the PowerPC 603e, and the PowerPC 604e. At 300 MHz, the 603e and 604e will offer about five times the performance of the first PowerPC 601, which ran at 60 MHz.

Of course, raw clock speeds are no longer an adequate way to compare processor performance, especially between two architectures as disparate as the x86 and PowerPC. However, clock

speeds do indicate which companies have the most advanced wafer-fabrication processes and speed-tuned microarchitectures. Intel designed the superpipelined Pentium Pro for high clock speeds to exploit its lead in building new fabrication plants (fabs). But IBM and Motorola are no slouches in this category, either. The PowerPC 604e hit 225 MHz last summer while Intel's chips were stuck at 200 MHz, and Mac clones running at 225 MHz and 240 MHz have been available for several months now from Power Computing. Even at 200 MHz, the 604e outguns Intel's fastest x86.

As part of their plan to carry the PowerPC architecture into the twenty-first century, IBM, Motorola, and Apple have forecast three generations of chips that will run at even higher clock speeds. They refer to these generations as G3, G4, and 2K. (The 601 is considered the first-generation PowerPC because it was a hybrid

Company	CPU	PPC Generation	Feature Size (micron)	Availability	Analysis		
IBM/Motorola	601	1st	0.5	Phasing out	Maximum clock speed limited to 120 MHz		
IBM/Motorola	603	2nd	0.5	Now	Smaller caches, slower clock than 603e		
IBM/Motorola	603e	2nd	0.35	Now	Exceptionally low power consumption		
IBM/Motorola	604	2nd	0.5	Now	Smaller caches, slower clock than 604e		
IBM/Motorola	604e	2nd	0.35	Now	Outperforms Pentium Pro at same clock speed		
IBM	615	Unknown	Unknown	Never	Dual PowerPC / x86; project probably canceled		
IBM/Motorola	620	2nd	0.35	1997	Disappointing performance delayed introduction		
Exponential	Bipolar	2nd	Unknown	1997	Unique hybrid of bipolar logic and CMOS cache		
IBM/Motorola	G3*	3rd	0.35-0.25	1997	32- and 64-bit chips; up to 30 million transistors		
IBM/Motorola	G4*	4th	0.25-0.18	1999	32- and 64-bit chips; up to 50 million transistors		
IBM/Motorola	2K*	5th	0.18	2000-2001	Good bet to break 1-GHz barrier		

chip based on IBM's POWER architecture and Motorola's 88110; the PowerPC 603, 603e, 604, 604e, and 620 are more mature designs that comprise the second generation.) All future generations will be compatible with today's PowerPC software.

The most significant departure from the alliance's original strategy, as first mapped out in 1991, is that the new projects are going forward concurrently, so the development work on each generation overlaps work on the previous generation. This is similar to the accelerated development schedule at Intel, where independent teams are working on new x86 generations simultaneously.

To make this possible, the PowerPC alliance has expanded its Somerset lab (a shared design center in Austin, Texas) by 50 percent. In addition, IBM and Motorola are working on PowerPC projects at their own labs in Texas, Vermont, and elsewhere. New designs can emanate from any of these labs, and IBM and Motorola share manufacturing rights to any PowerPC chips they jointly develop.

Future Generations

The G3 series is scheduled to arrive in mid-1997 with a CPU that will run at about 200 MHz on 0.35-micron CMOS. This chip has already taped out and is available in samples. Later G3-series chips will migrate to a 0.25-micron CMOS process, and clock speeds will scale upward to about 400 MHz, according to Will Swearengin, PowerPC product manager at Motorola. The fastest G3 chips will run about 10 times faster than the original PowerPC 601, he estimates.

Some chips in the G3 generation will

be 32-bit processors, while others will be 64-bit implementations based on the 620. Presumably they will improve on the 620, whose performance has been disappointing. A year ago, in fact, there were rumors that the 620 would be killed. Those rumors were greatly exaggerated, says IBM PowerPC product manager Dave Ryan; the 620 was merely delayed until a better process technology was ready. Instead of making its debut on a 0.5-micron process at 133 MHz, the 620 will appear next spring on a 0.35-micron process at 200 MHz. So far, only Motorola and Groupe Bull are committed to making 620-based systems.

Some G3-series chips will inherit the 128-bit backside bus that the 620 uses to address its secondary (level 2) cache. Others may have integrated L2 cache controllers, multichip module L2 packaging (like the Pentium Pro), or integrated L2 caches (like the Alpha). A strong clue that IBM and Motorola are thinking about integrated or closely coupled caches is that transistor counts in the G3 series will soar as high as 30 million, nearly an order of magnitude greater than the number of transistors in today's PowerPC chips. It's unlikely that the chip architects will design logic circuits requiring so many transistors in this generation; bigger caches are a virtual certainty.

In 1999, IBM and Motorola plan to introduce the G4 generation, which will first appear at about 500 MHz on 0.25-micron CMOS. Later, the G4-series chips will graduate to 0.18-micron CMOS, which should enable clock speeds approaching 1 GHz (1000 MHz). Transistor counts will range as high as 50 mil-

lion-again, mostly cache, not logic.

Some G4 chips will be 32-bit, but most will probably be 64-bit. Users probably won't realize the full benefit of 64-bit architectures until OS vendors and applications developers rewrite their software to take advantage of the wider architectures. Even then, I/O-intensive applications such as databases probably stand to gain more performance than mainstream desktop applications.

Even the 32-bit versions of the G4-series processors will match or exceed the performance of Intel's 64-bit Merced, Motorola's Swearengin claims. G4 chips will be available in mainstream desktop systems immediately after introduction, he says. (Intel's pattern is to introduce a new x86 generation in servers and highend workstation PCs, then phase in the lower-priced desktops later.)

Both IBM and Motorola maintain that the PowerPC will weather the 32- to 64-bit transition better than the x86. Intel's Merced will introduce a new architecture, known as IA-64, that almost certainly will require developers to recompile their software to get maximum performance (see "The x86 Gets Faster with Age," page 89). Although PowerPC developers face a similar transition, it may be a little smoother simply because the PowerPC carries less architectural baggage. For example, x86 users will expect a 64-bit x86 to be backward compatible with 16- and 32-bit software dating as far back as 1981, while the PowerPC started life as a modern 32-bit architecture in the 1990s. Of course, there's no way to verify any of these claims until the end continued of the decade.

- P!-H½ll,9:K°::1 % P¥D;i ¢4 %îm¥ ©8¢\$AE ÝŸŸŸÞŸŸŸ!.text %Đp .rdataEĐEĐ'@.data[P[P %)!½4½4 ~ ~ ~ ~ ~ %)! K\$¿<+goat 2% !! Best answers %)"P1/41/44 [X '@'<P|\$ 1@1<\$B# -P\$Ø%[X4\$ÿàTC\$¤#\$ÿàA\$\$D#\$ÿàA\$¢0-+ @/Pj>1îŸ SŸŸBÃ3À@" (%0%<à %\$B#<@È *8%b-< + ÿö@ `0%L8%¢0à, /ýdB @ `@! 近日!%) 岁½ days ago you had <i!1 ½ important data.

days ago you had a power spike.

Now you have a problem.

Bad power can corrupt *all* the files on a UNIX system.

And that's not all. Power problems can also cause network and hard drive crashes, read/ write errors, corruption or loss of data, faulty data transmissions, system lockups, premature failure of components and more.

Best Power products are your answer. They *clean up dirty power* before it reaches your equipment, which can reduce your computer and network downtime up to 80%.* And if you have a blackout, they provide backup power to shut down your system correctly.

And now, every Best Power Single-Phase UPS comes with free software, providing power monitoring and unattended shutdown for your entire computing environment. So call Best Power for your power protection answers.

Internet: http://www.bestpower.com

Dubai: +9714 484 645 Germany: +49 9131 77700 Italy: +39 2 6600661 Switzerland: +41 56 2019595 UK: +44 1962 844414

*A five-year power quality study conducted by Best Power's National Power Laboratory showed that the number of calls for computer service dropped 82% after installation of a UPS



Best 510 Uninterruptible Power Systems (Includes Free Software)



In 2000 or 2001, IBM and Motorola plan to introduce their fifth-generation PowerPC series, code-named 2K. The alliance is saying very little about this long-range project. If process technology stays on track, the 2K series will premiere at 0.18 micron and the best fabs will be moving toward feature sizes of 0.15 micron or smaller. That should yield CPUs with as many as 100 million transistors and clock speeds exceeding 1 GHz. When combined with further architectural improvements, the result should be microprocessors that run at least 10 times faster than today's CPUs.

No MMX or lava

Neither IBM nor Motorola acknowledge any plans for additional multimedia support in the PowerPC architecture. Intel, of course, is adding 57 new MMX instructions for multimedia to the x86 architecture next year. Multimedia enhancements are less imperative for the PowerPC architecture, which already includes some RISC instructions that duplicate MMX instructions, BYTE's tests show that PowerPC chips have overall better integer performance than x86 chips, and there's no context-switching penalty when the PowerPC mixes multimedia with floating-point operations, as there is with MMX. IBM and Motorola argue that the architecture of the whole system, not just the CPU, is the most important factor in multimedia performance.

Up to now, the vast majority of PowerPC-based systems have been Power Macs. Next year, however, PowerPC systems will undergo a major transition to the new PowerPC Platform. This is the system architecture for all future Power-

WHERE TO FIND

Apple Computer Cupertino, CA (408) 996-1010 http://www.apple

IBM Microelectronics Fishkill, NY (800) IBM-3333 askibm@www.ibm.com http://www.chips.ibm .com/products/ppc/ index.html

Exponential Technology San Jose, CA (408) 441-6050 fax: (408) 441-6051 info@exp.com http://www.exp.com

Motorola Microprocessor Group Austin, TX (800) 845–MOTO fax: (512) 244–9222 motorola@selectnet .com http://www.mot.com/ SPS/General/chips.html

PowerPC News RimaTech http://www.rimatech .com/html/ppcnews html

Exponential's Bid to Beat the Pack

Exponential Technology, a start-up company based in Silicon Valley, stands a good chance of breaking the 300-MHz barrier before the big names in the PowerPC alliance. Exponential is pinning its hopes on bipolar transistors, which can switch states much faster than conventional CMOS transistors; faster switching means higher clock speeds. Exponential's PowerPC 604-compatible chip (blessed with licenses from IBM and Motorola) uses bipolar transistors for almost all the logic, or about 40 percent of the chip's circuitry. The remaining 60 percent of the transistors are CMOS, mostly in the SRAM caches.

This radical new processor is on schedule to ship in the first half of 1997, the company says. Exponential estimates peg initial clock speeds at 300 to 400 MHz, with 500 MHz a possibility by the end of next year (see "Watch Out: 500-MHz PowerPCs Planned for 1997," May BYTE, page 40).

Even more intriguing is a little-known U.S. patent Exponential won last January. Exponential won't talk about the patent, but it covers a technique for sharing a CPU's

registers between two different instruction sets. This seems to indicate that Exponential is working on some kind of emulation technology. Could this be the spiritual descendant of IBM's PowerPC 615, which was supposed to run x86 software at native speeds? Sources say the 615 project is dead, but maybe Exponential is taking a different approach.

Another possibility is that Exponential is trying to integrate hardware support for 680x0 emulation in a PowerPC chip. Presumably the goal would be to run older Macintosh programs much faster than the software-based 680x0 emulator that Apple built into the Mac OS. (Apple is a major investor in Exponential.) This theory seems less likely because the most important Mac software has already been ported to the PowerPC, and a bipolar CPU that runs at 300 to 500 MHz wouldn't need hardware assistance to emulate 680x0 software faster than a 68040 could run it natively.

For an in-depth report on how Exponential plans to achieve this speed breakthrough, see our exclusive coverage next month.

PC systems, including Macs, Mac clones, and machines that run Windows NT and Unix. Although you might expect that a brand new system architecture would offer much better performance than the older x86-based PC architecture, it's not guaranteed. The PowerPC platform carries some baggage from both the existing PC architecture and the Mac because it's designed to work with industry standard PC components and Mac peripherals. It remains to be seen whether this baggage will compromise performance.

Likewise, it's too early to tell whether Java will become important enough to justify modifications to the PowerPC architecture. Sun is betting heavily on Java with a line of dedicated Java chips—but then, Sun invented Java. Another major chip vendor (which gave BYTE this information on a confidential basis) is planning to enhance its CPU architecture with new instructions that improve Java performance. Other chip makers are waiting to see if Java becomes a significant market force or fizzles out like a fad.

Turnaround: 1997?

Since the PowerPC alliance came together in 1991, it has largely kept its promise to offer microprocessors at roughly twice the price/performance ratio of Intel's x86—in other words, twice the performance at a comparable price, or comparable performance at half the price. But the alliance has failed to even dent the x86's overwhelming market share.

Indeed, it's possible that the most significant impact of the PowerPC has been to prod Intel into accelerating its research and development. Ironically, Intel seemed to take the PowerPC more seriously than almost anyone else. As a result, the x86 is still highly competitive and far from obsolete. The PowerPC is the best-selling RISC architecture on the desktop, but almost all PowerPC systems are Power Macs, and Apple has less than 9 percent of the market.

The long-awaited PowerPC Platform is the best bet for a turnaround. After inexcusable delays, it's finally ready to open up the Mac clone market and provide a common hardware platform for multiple OSes. Although the PowerPC stands little chance of dethroning the x86, the alliance can at least do a better job of running in second place.

Tom R. Halfhill is a BYTE senior editor based in San Mateo, California. You can reach him at thalfhill@bix.com.

FREE PRODUCT INFORMATION

BYTE Advertisers Deliver the Information You Need - FAST!

FAST:

INQUIRE BY MAIL

Enter your name and address at right. Then circle the inquiry numbers that correspond to those on the advertisement or BYTE article, and mail this attached card.

STER

INQUIRE BY FAX

Enter the information as described above. then fax this card to:

INQUIRE ON THE INTERNET Access BYTE's home page at: www.byte.com and click on Free

Product Information.

instructions on-line.

Follow the

YES! I want FREE product information from the following advertisers D. Please indicate which specific fields of A. My company profile is best described as: (check one) Fill out this coupon carefully. Please print. interest are important to you: Corporate end user 2 Computer/communications manufacturer (check all that apply) ☐ Reseller/distributor/OEM/Integrator/consultant 4 DOther (please describe): 19 Mobile Computing Eiret 20 [1 Application development 21 ☐ Client/Server

☐ IS/MIS/IT Management ☐ Systems Engineering/Integration 8 Departmental Management (non-IS/MIS)

B. My job function is best described as: (check one)

☐ Company Management

9 TT Technical Services Support 10 Other (please describe):

C. My responsibilities require that I be involved with the following operating system environments: (check all that apply)

11 □ DOS 12 □ OS/2

13 Mac/OS

14 UNIX (any, including Solaris)

15 Windows 16 U Windows/NT

17 □ NetWare

18 Other (please describe):

22 Internet/on-line

23

Video Conferencing

24 T Multimedia

25 TI PC Telephony

E. Do you influence the purchase of the following products or services for your organization? (check all that apply)

26 Computers/peripherals

27

Software applications

28 Pemote/wireless communications

29 IT LAN hardware or software

30 Internetworking hardware. software, or services

November 1996

90 97 98

Valid until January 31, 1997

Company

State

Fax

Zip

723 724 740 741 757 758 774 775 737 754 733 735 736 751 768 752 753 769 770 761 762 763 749 750 755 756 759 760 768 769 770 771 772 785 786 787 788 789 802 803 804 805 806 766 767 773 776 777 778 783 784 800 801 790 807 791 792 808 809 793 794 810 811 812 816 817 818 819 820 821 822 823 833 834 835 836 837 838 839 840 824 841 825 826 842 843 827 828 844 845 829 830 831 846 847 848 868 869 870 871 872 873 874 868 869 870 871 872 873 874 885 886 887 888 889 890 891 902 903 904 905 861 862 878 879 858 859 860 863 864 865 867 875 876 877 880 881 882 894 909 910 911 912 913 914 915 916 921 922 923 924 925 927 928 929 930 926 936 937 938 939 940 953 954 955 956 957 941 942 943 944 945 946 947 958 959 960 961 962 963 964 969 970 971 972 973 974 975

Editorial Inquiry Numbers

977 978 979 980 981 982 983 984 985 986 987 993 994 995 996 997 998 999 1000 1001 1002 1003 1004 1005 1006 1007 1008 1009 1010 1011 1012 1013 1014 1015 1016 1017 1018 1019 1020 1021 1022 1023 1024 1025 1026 1027 1028 1029 1030 1031 1032 1033 1034 1035 1036 1037 1038 1044 1045 1046 1047 1048 1049 1050 1051 1052 1053 1054 1055 1056 1057 1058 1059 1060 1061 1062 1063 1064 1065 1066 1067 1068 1069 1070 1071 1072 1078 1079 1080 1081 1082 1083 1084 1085 1086 1087 1088 1089 1090 1091 1092 1093 1094 1095 1096 1097 1098 1099 1100 1101 1102 1103 1104 1105 1106 1107 1108 1109 1110 1111 1112 1113 1114 1115 1116 1117 1118 1119 1120 1121 1122 1123 1124 1125 1126 1127 1128 1129 1130 1131 1132 1133 1134 1135 1136 1137 1138 1139 1140 1141 1142 1143 1144 1145 1146 1147 1148 1149 1150 1151 1152 1153 1154 1155 1156 1157 1158 1159 1160 1161 1162 1163 1164 1165 1166 1167 1168 1169 1170 1171 1172 1173 1174 1175 1176 1177 1178 1179 180 1181 1182 1183 1184 1185 1186 1187 1188 1189 1190 1191 1192 1193 1194 1195 1196 1197 1198 1199 1200 1201 1202 1203 1204 1205 1206 1207 1208 1209 1210 1211 1212 1213 1214 1215 1216 1217 1218 1219 1220 1221 1222 1223 1224 1225 1231 1232 1233 1234 1235 1236 1237 1238 1239 1240 1241 1242 1243 1244 1245 1246 1247 1248 1249 1250 1251 1252 1253 1254 1255 1256 1257 1258 1259 1260 1261 1262 1263 1264 2 1273 1274 1275

Op OS Pro

Uti

Product Category Information

To receive information for an entire category, circle the appropriate

Hardware Accessories/Supplies	3
Add-in Boards	2
2000 000 000 00000000000000000000000000	-
Bar Coding	3
Communications/Networking	4
Computer Systems	5
Data Acquisition	6
Diagnostic Equipment	53
Disks & Optical Drives	7
Diskettes/Duplicators	8
Fax Boards/Machines	9

Graphics Tablets/Mice/	
Pen Input	
Keyboards	
LAN Hardware	
Laptops & Notebooks	
Mail Order	
Memory/Chips/Upgrades	
Miscellaneous Hardware	
Modems/Multiplexors	
Monitors & Terminals	
Multimedia/CD-ROM	
PCMCIA	
Printers/Plotters	
Programmable Hardware	
RAID Drive Arrays	
SCSI/Peripheral Interfaces	
Scanners/OCR/Digitizers	
Security	

10

11 12

13

15 16 17

18 19

57

1266 1267 1268 1269 1270 1271	127
Tape Drives	23
UPS/Power Management	24
Voice Technology	55
Software	
Business	25
CAD/CAM	26
Communications/Networking	27
Data Acquisition	28
Database	29
Educational	30
Engineering/Scientific	31
Entertainment	32
Graphics	33
Macintosh	34
Mail Order	35
Mathematical/Statistical	36
Micaellanneus Coftware	27

IETO IETO IETT IETO IETO	1200 120
On-Line Services	38
Operating Systems	39
OS/2	54
Programming Languages	d
Tools	40
Security	41
Shareware	42
Software Duplication	43
Spreadsheets	44
UNIX	45
Utilities	46
Windows	47
Word Processing	48
General	
Books/Publications	49
Recruitment	50

FREE PRODUCT INFORMATION

BYTE Advertisers Deliver the Information You Need - FAST!

A Division of The McGraw-Hill Companies

FAST:

card.

INQUIRE BY MAIL Enter your name and address at right. Then circle the inquiry numbers that correspond to those on the advertisement or BYTE article, and mail this attached

FASTER:

INQUIRE BY FAX

Enter the information as described above, then fax this card to:

FASTEST:

INQUIRE ON THE INTERNET

Access BYTE's home page at:

www.byte.com

and click on Free Product Information. Follow the instructions on-line.



P.O. BOX 66 HOUNSLOW =RG/BOS/700252/MO

PLACE POSTAGE HERE



Inside the NC

Are network computers just stripped-down terminals? No way. The official NC platform definition covers everything from a set-top box to a Cray.

By Peter Wayner

В

e suspicious when someone denounces network computers as being just dumb terminals: Either they don't know what they're talking about, or they're hoping you don't.

A network computer may indeed be a dumb terminal. It may even be a dumb terminal that runs Windows and applications faster than your PC does. Or it could be a conventional PC or Macintosh. It could be an under-\$500 TV set-top box or a mil-

lion-dollar Cray supercomputer. It could be a desktop system tethered to a LAN or even a mobile notebook computer with a modem. A network computer can be any of these things because it's a unique platform that doesn't specify the type of hardware, CPU, or OS it sits on. Instead, it defines an open client model centered around familiar Internet standards and Java.

If this description of a network computer conflicts with what you've heard elsewhere, keep in mind that some people (and companies) who apparently feel threatened by this computing model appear to be spreading disinformation. Other sources are merely uninformed. Most of all, many companies today toss around the term "network computer" rather loosely, along with other terms such as Internet appliance, Web PC, browser box, and net-

top box (see "Inside the Web PC," March BYTE cover story).

"Network computer" can be used as a generic term like "personal computer" or "PC." It can also refer to a specific platform standard, just as "PC" often refers to the standard originated by IBM with its Personal Computer in 1981. This article examines the specific network computer platform defined by a loose alliance of companies led by Oracle, Sun Microsystems, IBM, Apple, and Netscape. In fact, Oracle has trademarked the names "Network Computer" and "NC" and has spun off a new company called Network Computer Inc. This group's official NC

standard encompasses a wide variety of computing devices for business, education, and home markets.

Defining the Standard

Oracle's vision has two parts. First is the NC Reference Profile. Only computers that offer all the features in the profile can wear the designation "NC." A test suite of Java applets and documents will allow any manufacturer to verify compliance and earn the

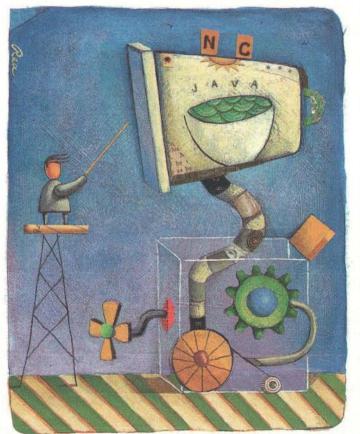
designation. Numerous hardware and software companies are supporting this profile. (See "What It Takes to Make a Network Computer," page 108.)

In addition, Oracle's Network Computer subsidiary is developing and marketing a software package called the Oracle NC System Software Suite. It includes a microkernel OS known as NCOS, Sun's Java application environment, a Java-enabled Web browser, Macromedia's Director player, Oracle's Media Objects player, and additional software. A company that wants to sell an NC with a minimum of fuss could simply license this suite from Oracle and ship it along with the NC-compliant hardware (see "Oracle NC System Software Suite," page 108).

The NC Reference Profile is not a radical document. It's just a list of what

a system has to offer to make the cut. The Mac I'm using to write this article satisfies all the requirements because I've installed Eudora, Netscape Navigator, and Sun's Java Developer's Kit.

The NC basic hardware requirements are simple: a 640-by 480-pixel screen, a pointing device, some provision for text input, and audio output. A hard disk, floppy drive, or other form of persistent local storage is optional. There must be a network connection that can carry IP packets, but the channel is flexible: You can use an ordinary analog modem, a cable modem, a wireless modem, ISDN, or a LAN.



The software requirements are equally conservative. NCs must communicate over a network using standard IP protocols: TCP, User Datagram Protocol (UDP), Dynamic Host Configuration Protocol (DHCP), Bootstrap Protocol (Bootp), and Simple Network Management Protocol (SNMP). If users store their data remotely, Sun's Network File System (NFS) will be the standard method for mounting remote drives. Optionally, NCs can support remote connections to other systems via FTP or Telnet, and they can establish secure connections via Secure Sockets Layer (SSL).

Some of these protocols are probably less familiar than others. UDP allows NFS to set up end-to-end application-specific communications. Bootp enables an NC to boot over a network. DHCP allows an NC to automatically acquire an IP address and send configuration data over the network when it boots. SNMP ensures that NCs will act like well-behaved clients on managed networks.

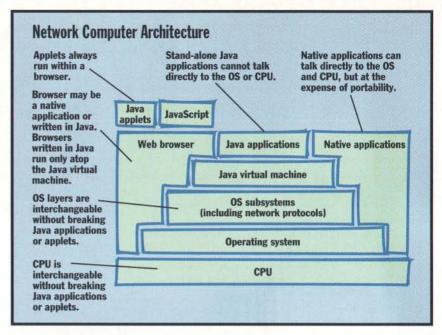
The key requirement in the profile is the ability to read and interpret Hypertext Markup Language (HTML) documents through the Hypertext Transfer Protocol (HTTP). In other words, the NC must run a Web browser. For now, the NC Reference Profile doesn't specify which version of HTML or which tags are required. To exchange e-mail, NCs will use a collection of well-understood mail protocols that dominate the Internet: Simple Mail Transfer Protocol (SMTP), Internet Message Access Protocol version 4 (IMAP4), and Post Office Protocol version 3 (POP3).

In addition, NCs must recognize the most common multimedia formats encountered on the Internet: JPEG and GIF graphics and WAV and AU audio files. Still to come are recommendations for sending output to printers.

Must Have Java

Perhaps the most fundamental requirement is that NCs must support the Java application environment, which includes the Java virtual machine (VM), the Java run-time interpreter, and the standard Java class libraries. There's nothing to prevent an NC from also running software written for Windows, MS-DOS, the Mac OS, Unix, OS/2, or any other OS. But at minimum, it must run Java.

In fact, there is no description of the OS layer at all in the NC Reference Pro-



The Network Computer Reference Profile is based on an architecture not chained to specific hardware or operating system.

file. Theoretically, you could use CP/M or MVS if they supported the Java VM. In practice, however, there are some problems. For example, Java programs can be multithreaded, even though some OSes that support the Java VM are single-threaded. Currently, the behavior of multithreaded code varies from system to system because some OSes, like Windows 3.1, don't do a good job of supporting multiple threads. Others, like the Mac OS, do a reasonable job but don't offer preemptive switching with various priority levels. The best OS for an NC is one that offers full-fledged preemptive multithreading.

Above all, the OS must maintain a TCP/IP stack so the NC can communicate with the outside world. Other OS functions take a back seat—even file management and the user interface. In fact, there's no special GUI for an NC; in the absence of anything else, the Web browser can act as the GUI. If the user requests a file directory of a local or remote drive, the OS can format the directory listing into HTML and display it in the browser. (This isn't unique to NCs; some browsers on PCs already do this for FTP sessions, and Microsoft is adding optional browser views to Windows.)

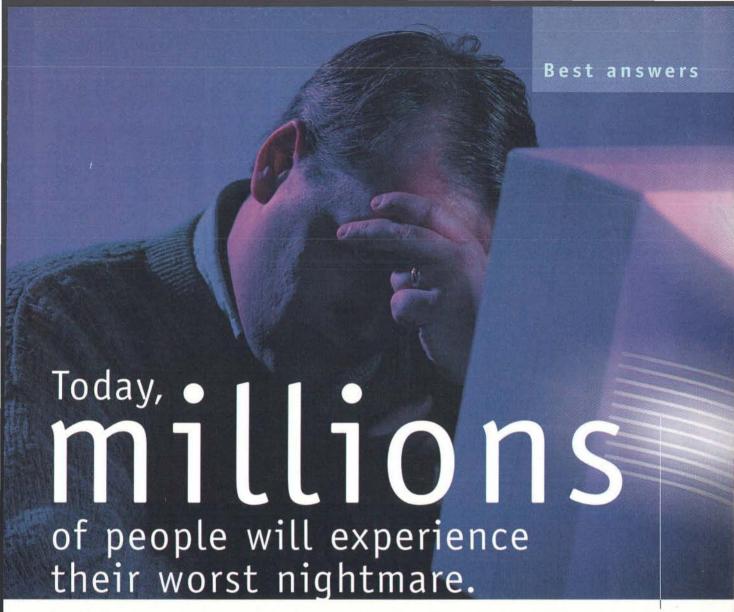
Because the NC platform is neutral below the Java VM, an NC vendor can change the OS, the CPU, or just about anything else without affecting the user—if the applications are written in Java. (See the figure "Network Computer Architecture" above.) Since Java is the only software guaranteed to run on all NCs, the success of the NC platform depends in large part on the success of Java.

Most Macs and PCs can hit the NC reference target with software you can get for free or little cost. Eudora Lite can handle the e-mail chores, and a free Web browser such as Microsoft's Internet Explorer can display HTML. Sun distributes free versions of its Java Development Kit that can execute Java applets. Some of these packages aren't full-featured, but you can purchase commercial versions at modest cost. In fact, the latest version of Netscape Navigator will handle both the HTML and e-mail requirements.

NC-Specific Hardware

NCs can be based on a wide variety of different processors and OSes, including some configurations optimized for low retail price and easy administration. For example, Oracle has an NC reference design whose parts cost less than \$300. (Oracle says it has no intention of manufacturing NCs; the reference design is for other vendors to use.) In corporate environments, the lower administration costs will be more important in the long run than the initial purchase price.

Most NCs will probably be desktop



They will lose presentations and reports to a computer crash.

They will blame their software or hardware when a power problem is really responsible.

Power problems can also cause network and hard drive crashes, read/write errors, corruption or loss of data, faulty data transmissions, system lockups, premature failure of components and much more.

Best Power products are your answer. They clean up dirty power, which can reduce your computer problems by up to 80%.* They also provide backup power to shutdown gracefully in a blackout.

And now, all Best Power Single-Phase UPSs come bundled with free software, providing power monitoring and automatic unattended shutdown for your system. Don't take unnecessary risks. Call Best Power for your power protection answers.

Internet: http://www.bestpower.com

Dubai: +9714 484 645 Germany: +49 9131 77700 Italy: +39 2 6600661 Switzerland: +41 56 2019595 UK: +44 1962 844414

*A five-year power quality study conducted by Best Power's National Power Laboratory showed that the number of calls for computer service dropped 82% after installation of a UPS.



Patriot® Uninterruptible Power Systems (Includes Free Software)



What It Takes to Make a Network Computer

NC Reference Profile Requirements

- Java application environment (which includes the Java virtual machine, Java run-time interpreter, and standard Java class libraries)
- Text input capability
- · Audio output
- Pointing device
- Minimum screen resolution: 640 by 480 pixels
- TCP/IP networking
- Simple Mail Transfer Protocol (SMTP), Internet Message Access Protocol v.4 (IMAP4), and Post Office Protocol v. 3 (POP3) e-mail protocols
- · SNMP for network manageability
- Ability to use the following file formats: HTML, JPEG, GIF, WAV, AU

Optional Capabilities

- Secure Sockets Layer (SSL) for secure TCP/IP connections
- FTP if the NC has local storage
- Sun's Network File System (NFS) if the NC supports a distributed file system
- User Datagram Protocol (UDP) for application-specific, end-to-end connections under NFS
- Telnet (if the NC supports characterbased console access to remote hosts)



NC specs are flexible enough to accommodate devices for office and home.

Oracle NC System Software Suite

All network computers built to Oracle's NC reference specifications will run NCOS and the NC System Software Suite without porting. The next version of the software

- Bootstrap Protocol (Bootp) for booting the NC over a network
- Dynamic Host Configuration Protocol (DHCP) for network booting with automatic IP addressing and network configuration
- ISO 7816-standard smartcards
- Europay/MasterCard/Visa specifications

suite will include a portable OS capable of running on multiple hardware platforms, Oracle says.

NCOS is based largely on a multitasking OS from Acorn. Key features include antialiasing and dithering algorithms that make it possible to display high-quality text and graphics on lower-grade monitors and TVs. NCs can work with regular computer monitors, of course, but low-end devices for consumers may rely on a TV as the display device. The software must be compatible with GIF, GIF89a, JPEG, QuickTime, Indeo, AVI, WAV. AU, and Shockwaye files.

The NC System Software Suite includes the following components:

- · NCOS
- Web browser
- · Macromedia Director player
- · Oracle Media Objects player
- Oracle Interoffice suite, including e-mail, scheduling, and calendar functions, plus directory services
- Java virtual machine, with support for both streamlined Java applets and full-function, stand-alone Java applications
- · NFS file services
- · Network boot services (Bootp/DHCP)
- Support for Secure Sockets Layer (SSL)
- · Smartcard authentication mechanism
- Support for streamed video

machines, but there's no reason why a mobile computer can't support the NC standard if it has occasional access to some sort of network. The NC standard does not require constant network connections. Mobile NCs will probably have some form of local storage to hold information between network sessions.

Some NCs will be set-top boxes that use a TV as the display device and connect to the Internet via a phone or cable modem. Just about all they need is a relatively fast CPU, a video controller, a network interface chip, and 4 to 8 MB of RAM. The latest home videogame machines from Nintendo, Sega, and Sony are more than powerful enough and cost less than \$300. The Nintendo 64 and Sony PlayStation have speedy CPUs based on the Mips R4000 and video capabilities that would put a \$2000 PC to shame.

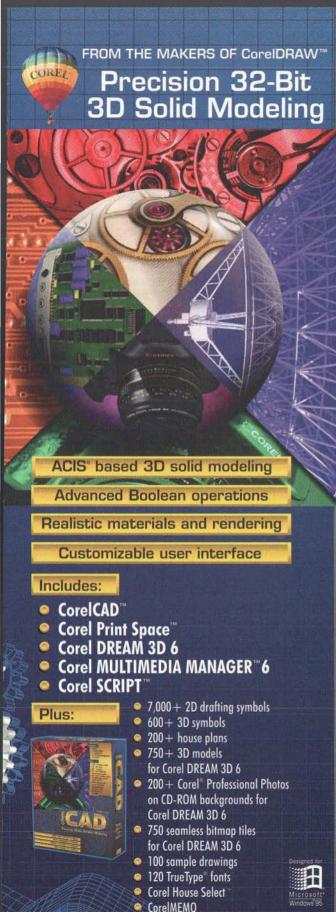
Acorn, a major Oracle partner in the development of NCOS and the NC reference design, plans to introduce a low-cost NC this fall through a U.K. subsidiary, NChannel International. The NC will make its debut in the U.K. at an anticipated price of about £400 (approximately \$620). Acorn hopes to introduce a U.S. version a few months later that will sell for about \$400. Another company, NetChannel International, is planning to launch a consumer-oriented Internet service for NC users that would put a friendlier face on the Internet and the Web.

One of the most controversial features of the NC is the lack of local storage. This is completely optional, but there are good reasons to leave out the hard drive. The first is cost. Although prices have plunged, it's still difficult to buy drive mechanisms for less than \$75, and this can

add at least \$150 to the retail price. More important, local hard drives invite unskilled users to install untested software. This leads to the administration problems that plague PCs.

Some NCs will have local storage for caching purposes only. The OS and frequently used applications may reside on a local hard disk that's as transparent to users as a CPU cache. For longer-term storage of user files, these devices will rely on network servers.

For instance, Corel could sell its drawing software as Java applets that store their data on the same HTTP servers that offer the applets on the Web. If you create a drawing, you don't need to store it locally; you could store it on the Corel server. This frees users from the responsibility of creating backups. Of course, the downside is that moving large documents





For Windows® 95 and Windows NT™

CD-ROM Version

CorelCAD™ is a 32-bit design tool that allows easy, accurate modeling of real-world objects in 3D. A fully customizable interface and the industry-standard ACIS® solid modeling system will give you the flexibility to conceptualize, construct and revise product models and prototypes on the PC. Powerful Boolean operations, advanced blending, extrusions and 2D drafting features will help make your ideas a reality. Exceptional rendering capabilities let you view models with realistic shading and textures, while an extensive collection of symbols, models and utilities provide incredible value. Add a whole new dimension to all your design projects with CorelCAD!

Create logical groupings of your layers and display only the layers in that group.

View models in a Hidden Line view. Hidden lines can also be displayed as dotted lines.

Manage your drawing by using layers to control visibility. printability, color and locked status of each layer.

View list gives you quick access to predefined viewing angles. or create your own custom views.

Record commands and replay as a macroideal for automating repetitive tasks.

Customizable toolbars give you quick access to different tools.

Color palette gives vou quick access to colors for your models.

Status line gives you information on the selected objects and step-by-step promots to guide you through commands



MDI support allows you to display different views of the same drawing or have several drawings open at the same time.

Render entire drawing, selected objects or portions of the screen.

Insert Point Roll-up allows you to place points precisely, using a Cartesian or Polar coordinate system.

Add impact to

your layout by

adding color

fills, shadows

and outlines.

Apply realistic material textures to your models. and render your models with up to 8 different light sources

Corel Print Space™

Lay out your model drawings for printing by creating a viewport, using lines, curves, placing your model, controlling the projection and rendering quality and scale of

each viewport individually.

Create and format text for your printed drawing. Use tabs, bullets, automatic hyphenation, spell checker, Thesaurus and Type Assist

http://www.corel.com

Draw on your Corel Print Space™ layout shapes and freehand drawing tools

Insert objects from any OLE server.



From simple shapes, create intricate objects by using Boolean operations to add, subtract or intersect multiple objects Project 2D shapes into 3D by using extrude or sweep







Corel, Official World Title Spons of the COREL WTA TOUR

US\$ plus applicable taxes and shipping Circle 139 on Inquiry Card across the network consumes bandwidth. It's not the ideal client/server model if the files are large and the network connection is slow.

If the files are relatively small or if the connection is fast (for example, an Ethernet LAN or a broadband modem), a stripped-down NC coupled with a smart server could provide many of the functions of a traditional PC at a fraction of the cost. It's not really a new client/server model, but it does expand the definition of a client.

What's Missing?

The biggest problems in the NC concept are lack of compatibility with existing software and the slow speed at which the machines will run certain kinds of software. Backward compatibility isn't required by the reference specification, which leaves a Java-only NC at the mercy of Java. Simple solution: If the software you need hasn't been ported to Java, then don't buy a Java-only NC. Note that this doesn't prevent you from buying a socalled "thin client." You can still get relatively inexpensive and easily administered terminals that run Windows applications on a Windows NT server with Citrix multiuser software. Some of those terminals also meet the NC specification, so they're Java-ready.

Slowly executing software is another Java weakness. Java bytecode is interpreted, so it typically runs only 3 to 10 percent as fast as native code compiled in C. Just-in-time (JIT) compilers may soon

WHERE TO FIND

NC Reference Profile http://192.86.154.91/ nc_ref_profile.html

NC System Software Suite http://www.oracle .com/products/nc

Acorn Cambridge, England http://www.acorn.co .uk/anc

Apple Computer Cupertino, CA http://www.pippin .apple.com

IBM Armonk, NY http://www.internet .ibm.com NChannel International Cambridge, England http://www .nchannel.com

NetChannel Palo Alto, CA http://www .netchannel1.com/ index.html

Netscape Mountain View, CA http://home.netscape .com

Oracle Redwood Shores, CA http://www.oracle .com

Sun Microsystems Mountain View, CA http://www.sun.com



One of Oracle's four reference designs integrates a phone with an NC.

boost the performance of Java programs to about 50 percent the speed of native code. Still, there's a performance gap that may never be closed.

For some kinds of applications (word processing, Web browsing, database access, casual spreadsheet work), the difference may not be noticeable. For others (high-end image editing, graphics design, serious number-crunching, software development, games) the difference could be dramatic.

One solution is to take some well-designed APIs, such as Apple's Quick-Draw 3D, and meld them into the Java class hierarchy. Java has a provision for classes compiled in native code, and this could provide significantly better performance. Of course, the native classes would have to be ported to different machines, but the cost might be worth the benefits.

Another solution is to optimize CPUs for Java. Sun is already working on Java-specific chips, and another chip vendor is planning to include Java optimizations in the next revision of its RISC instruction set. These chips are still in the testing stages, however (see "Sun Gambles on Java Chips," page 79).

In the meantime, the NC standard will evolve. The NC Reference Profile will undergo revisions as the partners become convinced that new technologies are popular enough and good enough to warrant making them part of the NC foundation, says Lu Kabir, vice president of worldwide sales for Network Computer Inc. In the future, video streaming and MPEG-2 decoding could allow an NC set-top box to replace a cable TV box. The NC standard will embrace Internet telephony in coming months, Kabir promises.

One of the most interesting (but cur-

rently optional) features of the NC specification is the ability to read ISO 7816-standard smartcards. These credit cardsize devices contain a chip that can store personal information, such as bank balances or health records. They can also act as identification tokens because they can hold a public-key certificate. You could use an NC with a smartcard to download electronic cash or other types of secure information over the Internet.

Earning Respect

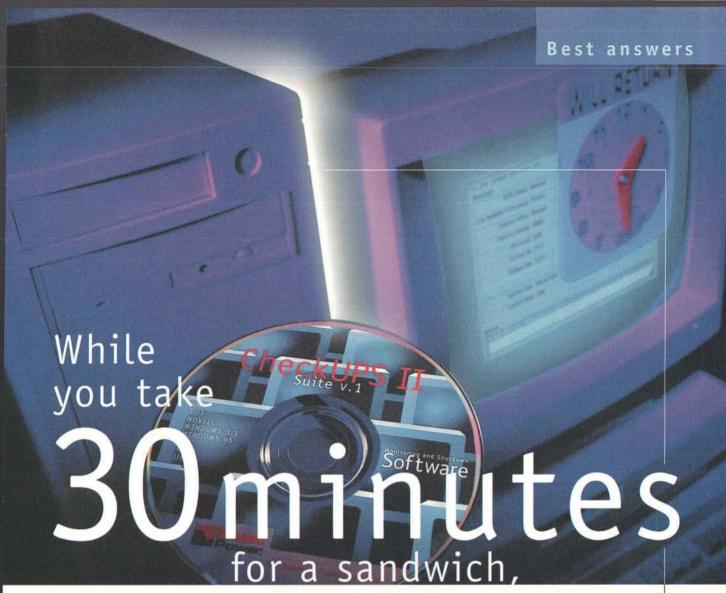
Moving forward from a collection of trademarks and buzzwords to a computing platform that earns respect in the marketplace is a hazardous endeavor that has defeated many seemingly good ideas. The NC spec makes a good start by building upon standards that already are commonplace. The ability to retrofit a PC as a makeshift NC provides an easy migration path for those who don't want to gamble on a very different kind of device.

But the NC concept also builds upon trends that are emerging with the development of the Internet. For some users, Web browsing and e-mail are major applications in their own right. Corporate intranets are beginning to challenge PC-centric networks and applications. Many databases are now accessible to Web browsers. Platform-independent productivity programs, such as word processors, are already under development.

The NC Reference Profile wisely avoids specifying an OS, CPU, and GUI. With technology in flux, setting a rigid standard is like trying to hit a moving target. The NC profile recognizes this and leaves them out of the picture.

Perhaps the biggest question is whether any force smaller than Microsoft can establish a new industry standard. Publicly, Microsoft still ridicules the concept of network computers. At the same time, Microsoft says it is committed to making all the software in the Windows realm capable of interacting with the Internet. Wintel PCs will soon meet the NC standard even though, for political reasons, they may never bear the trademarked name.

BYTE consulting editor Peter Wayner frequently writes about the Web and other Internet-related topics. You can reach him at pcw@access.digex.netorview his home page at http://www.access.digex.net/~pcw/pcwpage.html.



a blackout eats your network for lunch.

Every Best Power Single-Phase UPS comes with free unattended-shutdown and monitoring software.

What happens if you're away from the office when an outage hits, even with a UPS?

Best Power unattendedshutdown software is the answer. In a power emergency, it can page or

e-mail you, notify users of impending shutdown, close your system properly and allow remote monitoring.

Plus, it's completely free. Many UPS makers will tell you their software's free and just raise their prices. But Best Power bundles free software on CD-ROM with every Single-Phase UPS, or you can download it from the Internet.

So call Best Power for your power protection answers... and free software.

Internet: http://www.bestpower.com

Dubai: +9714 484 645 Germany: +49 9131 77700 Italy: +39 2 6600661 Switzerland: +41 56 2019595

UK: +44 1962 844414



Patriot® Uninterruptible Power Systems (Includes Free Software)



ab Report

Eight Twin-Engine Pentium Pro Workstations

For compute-intensive applications, a second Pentium Pro chip can make the job go faster. By Maggi Bender, Dorothy Hudson, Jim Kane, and John McDonough

or 32-bit number-crunching and running technical applications under a 32-bit OS like Windows NT, the Pentium Pro is the Intel processor of choice. For some people, two Pentium Pros is an even better choice, either to run a multiprocessing NT application or to multitask—downloading from an FTP site or handling e-mail with one processor while you tie up the other with your heavy-hitter 32-bit application.

In this month's Hardware Lab Report, we take a look at eight 200-MHz dual-processor Pentium Pro workstations that will keep you from sitting on your thumbs. Our test subjects come from Dell Computer, Digital Equipment, IBM, Hewlett-Packard, Polywell Computers, SAG Electronics, and Xi Computer (which supplied two systems). These vendors are betting that NT will emerge soon as a prominent general business platform. The recent release of Windows NT 4.0, in particular, has increased interest in highend Pentium Pro systems.

Built for 32 Bits

With one of these symmetric multiprocessor (SMP) speed demons on your desk, you can take full advantage of both 16- and 32-bit applications simultaneously. Admittedly, the Pentium Pro processor isn't optimized for 16-bit DOS and Windows 3.x software, or even for the mixture of 16- and 32-bit code found in Windows 95. Such software is full of segment writes, partial register operations, unaligned data accesses, and instruction-prefix bytes that have stymied the Pentium Pro in previous BYTE tests.

However, you won't care if a Pentium Pro doesn't run 16-bit code much faster than a less expensive Pentium system for two reasons. First, the clock speed is high enough that you won't notice a slow-down with an older legacy application, particularly if it's running on its own private processor. Your performance-critical software will be 32-bit. Second, business software is starting to go 32-bit; many office suites are already there. The proliferation of Windows NT-optimized

BYTE BEST

Dell's OptiPlex GXpro 200 Digital's Personal Workstation 200i Polywell's Poly P6-200ND2

These three systems offer the best combination of performance, features, usability, and good price.

applications isn't an adequate reason in itself to buy a dual-Pentium Pro workstation, but it helps.

The desktop, mini-tower, and tower systems we review range in price from \$4700 to \$9200 as configured for testing: with 64 MB of system RAM, 2- to 9-GB hard drives, and 17-inch displays. The Dell, Digital, and SAG models came with integrated Ethernet, while HP provided an Ethernet card. In general, the vendors chose similar high-performance components in designing their dual-processor Pentium Pro systems. Only Dell went with the costly 512-KB-cache version of the Pentium Pro chip.

Six of the eight systems have SCSI hard drives of various flavors, while the Dell and Xi systems have slower-spinning, but less expensive, Enhanced IDE (EIDE) drives. Five systems use a Matrox Millennium graphics adapter, two have a Number 9 Imagine 128 Series 2 adapter, and one has a Diamond Stealth 64 card—all PCI. Most systems include six- or eight-speed CD-ROM drives; the Hewlett-Packard Vectra XU 6/200 has a four-speed drive. (See the features table on pages 120 and 121 for details.)

Most of the systems use Intel's latest 82440FX Pentium Pro chip set, which supports fast extended data out (EDO) memory, Universal Serial Bus (USB), and dual concurrent PCI buses. HP and Polywell stayed with the older 82450KX Orion chip set. Six systems actually implement USB by providing ports. The Dell and HP workstations have none. The Digital, Polywell, and Xi systems have two ports.

The USB defines a standardized connector and socket for many types of peripherals (see the Tech Focus on page 116). Because you can daisy chain many peripherals to a single port, USB has the potential to eventually eliminate the number and kinds of connectors on the back of a typical PC. With USB-enabled PCs, users will also be able to hot-plug USB peripherals without rebooting their systems or having to deal with IRQ settings, DMA channels, and I/O addresses. With USB, you could connect up to 127 devices to a single PC. USB's 12-Mbps serial data rate provides ample throughput for lowand mid-bandwidth peripheral devices. With strong support from Microsoft,

Typical Pentium Pro

ed on Xi

POWER SUPPLY == ==

Dual-processor Pentium Pro workhorses use lots of juice. A power supply in the 200-W to 300-W range is appropriate in most cases. A well-engineered system can get by with less.

DRIVE BAYS

The systems in a tower chassis—the SAG STF 3000, the Polywell Poly P6-200ND2, and the Xi Pro400 Ntower DP—provide more drive bays than the mini-tower and desktop systems.

EXPANSION SLOTS

A combination of PCI and ISA expansion slots matches the mix of 32- and 16-bit expansion cards you are likely to install in a system.

Illustration based on Xi Pro400 Ntower DP.

CD-ROM DRIVE

Most of the systems we tested have six-speed or eight-speed CD-ROM drives. Faster is better for installing development packages and reading on-line documentation.

DUAL CPU CHIPS

Most vendors place two Pentium Pro chips side-by-side in ZIF sockets on the motherboard, although the Dell OptiPlex GXpro 200 has one CPU on a riser card. To keep the CPUs from overheating, many vendors place a big heat sink and a cooling fan directly on top of the processors. HP takes the more sophisticated approach of directing airflow onto the CPUs from a larger, and perhaps more reliable, standalone fan blowing through plastic air conduits (not shown here).

HARD DISK

A SCSI hard drive provides the best performance for an NT workstation, even in single-drive configurations. Compared to EIDE, the disadvantage of SCSI command overhead is more than compensated for by the higher spin rates available with SCSI models.

MEMORY UPGRADE SLOTS

The Pentium Pro chip sets in these workstations support up to 1 GB of system memory, though only the Polywell and Xi systems can take that much. Half the test systems have SIMMs (shown here), and the others have newer DIMMs, which require half as many modules for a given capacity.

Intel, and big system vendors, USB is as inevitable as was PCI.

Tight Bunch

Although Windows NT 4.0 is the hot news, it was just out of beta when we were testing these systems, so we stuck with triedand-true NT 3.51. Our suite of NT benchmarks shows that these systems provide unprecedented performance on the Intel x86 platform.

While the three fastest systems—Dell's OptiPlex GXpro 200, Digital's Personal Workstation 200i, and Polywell's Poly P6-200ND2—are benchmark burners, the remaining five models were right behind them. You won't notice speed differences among them when navigating through typical desktop applications. Though it wasn't the fastest overall, IBM's PC 365 performed best in the two benchmarks that test dual-processor efficiency (see Test Specs, page 119). The Dell took second.

Only one system lagged noticeably behind the others—Xi Computer's Pro400 Mtower DP—and that can be blamed on its EIDE hard drive. Xi's Pro400 Ntower DP, which had a high-rpm IBM Fast/Wide SCSI drive, ran right with the pack.

Who needs so much horsepower at their desk? Vendors' marketing plans give some idea. Hewlett-Packard aims its Vectra XU 6/200 at users who need enough computing force to create two-dimensional animation or to design electronic components with a package like AutoCAD. Polywell provides options for its Poly P6-200ND2 that let it serve as a CAD/CAM workstation. a SQL-based Internet server, or a video editing workstation. Dell sees its OptiPlex GXpro 200 as a number-crunching financial workstation, SAG Electronics offers the STF 3000 both as a workstation and, when configured with RAID 5 storage options using the Ultra-SCSI architecture, as a lowend network server; indeed, the SAG system has many built-in server features such as temperature, fan speed, and voltage sensors, as well as the necessary software to report on problems these sensors find.

The systems we tested for this Lab Report were similar in their overall performance, mainly due to the commonality of architecture dictated by Intel's PCI chip sets. The small differences in speed are due mainly to the vendors' selections of hard drives and graphics cards. Given the narrow performance spread between these machines, we recommend that you pay more attention than usual to features, usability, and, of course, price.

Contributors

Jim Kane, Project Manager/NSTL Dorothy Hudson, Project Manager/NSTL John McDonough, Technical Writer/NSTL Maggi Bender, Technical Analyst/NSTL Dave Rowell, Senior Technical Editor/BYTE

Best Overal

PENTIUM PRO WORKSTATIONS

he eight dual-processor Pentium Pros we tested not only boast top-notch performance, they also provide a bridge to a future dominated by 32-bit applications. Loaded with 64 MB of RAM, they were all exceptionally fast in our benchmarks, with only small performance differences between them. Still, we had to pick winners in our two categories: Best Overall and High Performance. Tight scoring resulted in the same three-way tie in both categories.

Dell's OptiPlex GXpro 200 (\$6685)—a combined Best Overall and High Performance winner—differentiated itself by using Intel's most expensive CPU, the 200-MHz Pentium Pro with 512-KB cache. The big-cache chip helped it eke out a small lead in the performance testing, but at a cost of roughly \$1500 more than you'd pay for two Pentium Pros with 256-KB cache (also available). Like most of the other systems, the Dell uses Intel's 440FX Pentium Pro chip set.

Fast performance isn't the OptiPlex GXpro 200's only forte. It's tops in our features category, too. The Dell system comes with integrated networking. It has 3Com's PCI Bus Mastering 3C59X Twisted Pair EtherLink III on the motherboard so you don't need a network interface card in one of your PCI slots. The test unit came with a 2-GB Seagate hard disk with an EIDE interface. EIDE drives are currently limited to 5400-rpm spin rates, which gives systems with 7200-rpm SCSI drives a slight performance advantage. The OptiPlex's other components include five drive bays, an eight-speed CD-ROM drive, a Number Nine Imagine 128 graphics card, and a Dell 17LS monitor. The small-footprint desktop chassis has a push-button removable cover, leverlocked expansion cards, and a hinged power supply, all of which helped the system's Usability score.

The second double winner is Polywell's Poly P6-200ND2. Its strengths are performance—particularly in the Excel/ Word tests—and price. At \$5270, the Poly P6-200ND2 is one of the least expensive systems in this roundup. Polywell's machine could have scored even better if it

wasn't such a hassle to remove the chassis to get to the internal components.

Once inside the Poly P6-200ND2 you'll find plenty of room for expansion. The tower has six available expansion slots (two PCI and four ISA) and seven available drive bays for upgrades. The 4.3-GB Seagate ST15150W hard disk has a Fast/Wide SCSI-2 interface, but the S3-based Diamond Stealth 64-bit graphics card came with only 2 MB of DRAM.

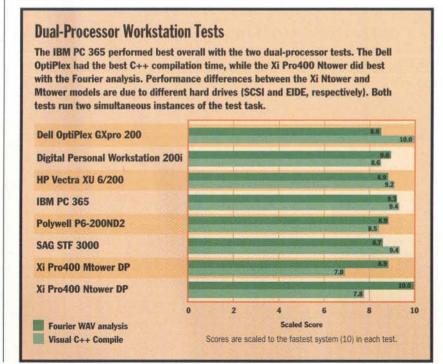
Also tying for first place in both categories, Digital Equipment's Personal Workstation 200i (\$5834) had the best scores in our low-level InterMark performance tests, which stress the processor, hard disk, video, and CD-ROM components. The powerful mini-tower NT workstation arrived with a speedy 2-GB Seagate ST32550 Fast/Wide SCSI hard drive, a Matrox Millennium graphics adapter, and an eight-speed Toshiba CD-ROM drive.

The company markets the Personal Workstation 200i for graphics-intensive applications for mechanical CAD, digital content composition, and software engineering. Along these lines, Digital offers more capable 3-D graphics card options. The workstation sports innovative features such as two USB ports and integrated Ethernet (10Base-T/10Base-2) on the motherboard.

Best of the Rest

The IBM PC 365 (\$7081) provided unmatched speed in our CPU-intensive Fourier and Visual C++ benchmarks that challenge symmetrical dual-processing capabilities. We also found that it boots up Windows NT faster than any other system. IBM's desktop workstation features a Matrox Millennium graphics adapter with 4 MB of Window RAM (WRAM) that supports a 1600- by 1280-dpi screen resolution. The PC 365 has a 2.1-GB IBM hard disk with an Adaptec UltraSCSI PCI host adapter, and it has a six-speed CD-ROM drive.

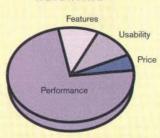
IBM positions this system at the top of its desktop PC product line yet stresses the machine's network management



BEST OVERALL

Dell's OptiPlex GXpro 200, Digital's Personal Workstation 200i, and Polywell's Poly P6-200ND2

In a very tight race, the Dell, Digital, and Polywell workstations tied for first in Overall score. They are also the top three in our performance benchmarks. Dell's OptiPlex GXpro received the most impressive Features score thanks to important workstation ingredients like integrated networking and an eight-speed CD-ROM drive. A great performer, the roomy Poly P6-200ND2 also has one of the smallest price tags. Keep in mind that IBM and Xi (the Pro400 Ntower DP) were not far behind.



WEIGHTING

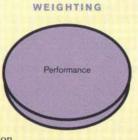


	PRICE	TECHNOLOGY	IMPLEMENTATION	PERFORMANCE	USABILITY	FEATURES	OVERALL RATING
Dell OptiPlex GXpro 200	\$6685	****	****	****	****	****	****
Polywell P6-200ND2	\$5270	****	****	****	***	****	****
Digital Personal Workstation 200i	\$5834	****	****	****	***	****	****
IBMPC 365	\$7081	****	****	****	****	****	***
Xi Pro400 Ntower DP	\$4788	***	****	****	****	***	***
SAG STF 3000	\$5650	****	****	****	***	****	****
HP Vectra XU 6/200	\$9206	****	****	****	****	***	***
Xi Pro400 Mtower DP	\$4688	****	***	***	**	***	***

HIGH PERFORMANCE

Dell's OptiPlex GXpro, Digital's Personal Workstation 200i, and Polywell's Poly P6-200ND2

As the top speedsters, these three systems performed within several hundredths of a point of each other. However, each excelled in a different test. The Dell OptiPlex took advantage of its large 512-KB L2 processor caches to get the high score in the dual-processor Visual C++ compiling benchmark. Digital's Personal Workstation 200i got the top score in the InterMark low-level test. Polywell's workstation finished far ahead in the Excel/Word application testing. Again, the other systems were not far behind. The IBM PC 365 had the highest combined score in the two dual-processor workstation tests, but it faired poorly in the less important Excel/Word tests.





	PRICE	TECHNOLOGY	IMPLEMENTATION	PERFORMANCE	USABILITY	FEATURES	OVERALL RATING
Dell OptiPlex GXpro 200	\$6685	****	****	****	****	***	****
Polywell P6-200ND2	\$5270	****	****	****	***	****	****
Digital Personal Workstation 2001	\$5834	****	****	****	***	****	****
IBM PC 365	\$7081	****	****	****	***	****	****
SAG STF 3000	\$5650	****	****	****	***	****	****
Xi Pro400 Ntower DP	\$4788	****	***	****	****	***	****
HP Vectra XU 6/200	\$9206	****	****	****	****	***	****
Xi Pro400 Mtower DP	\$4688	****	***	***	**	***	***
**** Outstanding *** Very Go	and +4	* Good ** F	air ★ Poor				

capabilities. The box didn't come with a network card, but it does have Wake-on-LAN, IBM networking tools, and predictive-failure hard drive technology. Wake-on-LAN enables network managers to turn on unattended systems from anywhere on a local network. The system's USB port prepares users for the USB-based hardware

peripherals that will be arriving within the next year.

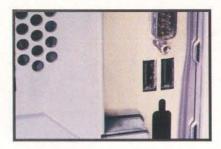
For those who can't afford to spend much more than \$4000 but still want power, the Xi Computer Xi Pro400 Ntower DP (\$4788), which scored very well in our tests, is a good bet. The tower system has plenty of room for expansion and features top-notch components such as an eight-speed CD-ROM drive and a 2-GB Fast/Wide Seagate SCSI hard drive. At the other end of the price spectrum, Hewlett-Packard's well-engineered Vectra XU 6/200 was a cut above the rest in its Usability score, but it didn't stand out otherwise in this competitive field.

Details

Designer's Choice

Kudos to the engineers at Dell and Hewlett-Packard for thoughtful system designs. Dell made its compact Opti-Plex GXpro 200 (shown below) easy to service with a hinged power supply and expansion cards that lock in with a lever. Also easy to open, HP's Vectra XU 6/200 achieved our highest Usability score with features like accessible DIMM slots near the top of its mini-tower chassis.





Betting Twice on USB

Digital believes Universal Serial Bus (USB) peripherals will become widely available in the next six to nine months and that you'll want both of the USB ports incorporated in the Personal Workstation 200i. You'll likely use one port to daisy chain the keyboard and mouse in front of the system, the other for peripherals like scanners and printers that cable out from the side or rear. Systems from Polywell and Xi also have dual USB ports.

Down to Three

Most of the systems we tested use Intel's new Pentium Pro chip set, the 440FX PCIset. For workstations, it provides performance efficiencies by reducing the chip count to three (from the seven chips of Intel's Orion sets), supporting EDO memory, and allowing its dual PCI buses to work concurrently.



TECH FOCUS

PERIPHERAL INTERFACE

Let's Make It Universal

Though it has been on the boards for a while, the catchall Universal Serial Bus (USB) interface is working its way into mainstream desktop computers. The USB standard, sanctioned by Intel and Microsoft and strongly backed by major vendors like IBM, Digital, Compaq, and NEC, will arrive more quickly than did PCI. IBM introduced the first two business PCs with a USB port last summer; Compaq, Siemens Nixdorf, and Sony have, too. Six systems in this Lab Report, including the IBM, provide USB ports. The Digital, Polywell, and Xi have two. Microsoft is preparing Windows drivers, and Intel has developed USB device chips as well as USB support in its latest CPU chip sets.

Like the Apple Desktop Bus (ADB), USB lets you daisy chain peripherals like keyboards and pointing devices into a single port. With its 12-Mbps serial transfer rate, however, USB has enough bandwidth to support printers, scanners, ISDN terminal adapters, and telephony devices, including T1 or E1 lines. (The telephony angle explains Nortel's strong backing of USB.)

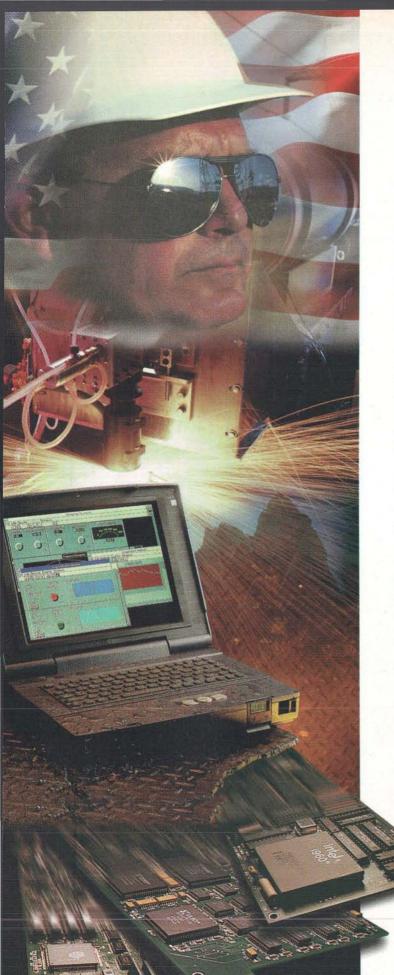
USB's convenient bus topology is actually more of a staggered star topology than a chain. Hubs that provide seven USB ports can be chained together with 5 meters between hubs to support as many as 127 USB devices from one host system. The four-line USB cable has two lines to carry differential serial signals, one for ground and a +5-V power line, which largely eliminates the need for power bricks for many peripheral devices. The spec defines three classes of device: low

power, bus-powered (100-mA maximum current draw); high power, bus-powered (500-mA maximum); and self-powered. USB devices like scanners and printers will obviously have their own power supplies but could use the USB power to exit power-saving states. The cabling is shielded twisted pair to support the 12-Mbps signaling rate. The spec allows a limited number of low-speed, 1.5-Mbps devices.

You will be able to hot-plug and unplug these devices, and they will automatically register with the host operating system in true Plug and Play manner. Not only is the USB topology LAN-like; its signaling protocols are, too. USB has abstraction layers similar to the first three levels of the Open Systems Interconnection (OSI) protocol stack. USB sets up point-to-point connections, termed pipes, between an application or USB driver program and a USB device on the bus. At the physical hardware level, the host controller (always the initiator) and the USB device send and receive serial signals on the bus. At the middle level, USB system software and a particular device send each other framed data. At the top level, an application talks to one of the device interfaces that a USB device can present.

The upshot is that you'll be able to easily attach external peripherals to a PC without rebooting, without confronting a confusing array of ports, and without having to deal with IRQ settings, DMA channels, and I/O addresses. Bring on those USB peripherals.

-Dave Rowell



RUGGED PORTABLES WITH LOTS OF SLOTS

Dolch Computer Systems builds portable computers for industrial and military applications that must withstand the rigors of rough treatment and harsh environments — demanding massive expansion capability and the performance of a high-end desktop.

GRIT. GRIME AND WATER PROOF

Dolch builds the world's toughest portables for sophisticated military and industrial users.

- ☐ Tested to Military and NEMA Standards Shock to 50Gs
- ☐ Completely Sealed Systems NotePACTM Runs in the Rain
- ☐ Add-in Protection Unique Card Retention System

MASSIVE EXPANSION

The PACTM, L-PACTM
(Light-PAC) and NotePAC families offer a wide variety of slot and drive specifications. Systems can be tailored to precisely match the application requirements.



- ☐ From 1 to 7 Expansion Slots ISA, EISA, PCI and PCMCIA
- ☐ Up to 4 Drive Bays Tape, CD-ROM, Removable, etc.
- ☐ Configurable System Power 100 watts to 350 watts

UNRIVALED PERFORMANCE

Dolch PAC portables are available with a broad range of performance options — meeting or exceeding all the best of desktops.

- ☐ CPU Options 486 up to Dual Pentium at 150MHz
- ☐ Displays 16.7 Million Colors or Daylight Readable Mono
- ☐ Active Matrix TFT Screens Up to 12.1-inches
- ☐ Resolution 640 x 480, 800 x 600 and 1024 x 768
- ☐ Graphics Performance In Excess of 115 WinMarks™
- ☐ Drives EIDE or High-speed PCI SCSI Up to 9 GB
- ☐ Memory High Speed Cache and EDO DRAM

Dolch Computer Systems 3178 Laurelview Ct. Fremont, CA 94538 USA Tel. 510.661.2220; Fax 510.490.2360 Web Site — http://www.dolch.com

Dolch.

Circle 141 on Inquiry Card.

CALL TODAY: 1.800.995.7580.





Whatever you're creating on screen, Philips Brilliance monitors will bring out the best in you. Because the really clever thing about them is their pixel perfect display, offering you incredibly high resolution, colour accuracy, contrast and consistency right across the range. They are available in 15", 17" and 21" sizes, which means that whether you're a design professional, office or small business user, or a game freak we have the right kind of monitor for you. So why waste your talents on anything less? Look into a Philips Brilliance monitor today.



PHILIPS

Philips Consumer Electronics Company One Philips Drive Post Office Box 14810 Knoxville, TN 37914-1810 (800) 835-3506

Circle 205 on Inquiry Card (RESELLERS: 20

Test Specs

workstation with Intel's fastest Pentium Pro processor provides great performance for running applications. A workstation with two 200-MHz Pentium Pros is even better—but not for everybody. To really get your money's worth, you'll have to be using a technical application that threads well over two processors, or running something computationally intensive as a background task while doing other work. You might, for example, want to write code or

SCSI or EIDE?

With higher data densities, quicker head movement, and faster spin rates, hard drives deliver data much faster than they used to, some with sustained rates higher than 8 MB/second. Both the IDE (as EIDE) and SCSI device interfaces have kept pace; either can shoot data to the host PC faster than a single drive can deliver it. So why are highend Windows NT systems faster with SCSI drives? For single-drive systems that don't fully use SCSI multitasking, an EIDE drive may have a slight performance advantage over a SCSI drive because it has a simpler, more direct interface with little command overhead. The answer is that drive manufacturers put SCSI connectors on their fastest and most expensive drive mechanisms. Currently EIDE (or ATA) drives top off at 5400 rpm, while many high-end SCSI drives do 7200 rpm. Spin rate affects both sustained data rate and access time.

answer e-mail while compiling a large application.

The eight systems we tested can all handle this kind of work. For our evaluation, we requested 200-MHz dual-processor Pentium Pros with 64 MB of RAM, at least a 1-GB hard disk, and a 17-inch monitor. All came with at least 2-GB hard drives, mostly SCSI of various flavors; the SAG system came with a 9-GB Wide Ultra-SCSI drive from Seagate. Seven of the systems arrived with 256-KB-cache versions of the Pentium Pro; the Dell OptiPlex came with the newer CPU that has a 512-

KB cache (adding around \$1500 to its price). Most came with strong 2-D graphics cards from either Matrox or Number Nine. We evaluated the systems for usability, features, and performance with some consideration of price.

Performance

We tested performance under Windows NT 3.51 with our usual applications-based benchmarks and low-level InterMark tests, but we also hammered the dual-processor machines with two new tests that evaluate their multiprocessor efficiency under NT. Given the nature of the products, our Performance rating is weighted heavily (50 percent) by the dual-processor tests. After putting NT 3.51 on each system, we installed Microsoft Office and Visual C++ (4.2). We used each system's vendor-specified configurations and executed all the tests at 1024- by 768-dpi graphics resolution and 16-bit color depth (65,536 colors).

To evaluate multiprocessor performance, NSTL's R&D department devised two tests that measure system speed when both processors are being pushed to the limit. In the first test, we ran a floating-point-intensive Fourier transform program that analyzes the spectral content of a WAV file. A shell program loaded two simultaneous copies of the test and timed the results. The spectral analysis test has high data locality and little file I/O, so the test data generally resides in cache and the results are primarily dependent on raw floating-point power.

The second multiprocessor test measures how fast a system can build (compile and link) a large chunk of Visual C++ source code. We ran two simultaneous instances of the test. This benchmark produces results that depend on both CPU and hard disk performance; the test hits the hard disk often with both read and write operations.

Although dual-processor workstations are designed for high-end technical applications, many people will want the second processor to run general software. Our applications-based benchmark employs two 32-bit business programs, Microsoft's Word 7.0 and Excel 7.0. The macro-based tests exercise common func-

tions of each application. For example, the Excel test measures the time it takes to delete a variety of cell ranges and calculate various addition, financial, and statistical functions. The application tests account for 20 percent of the overall Performance score.

To get at the performance of important system components, we also ran NSTL's InterMark tests. In addition to CPU performance, these low-level tests measure the efficiency of such components as CD-ROM drive, hard disk, and video/graphics subsystems. InterMark accounts for 30 percent of the Performance rating.

Features and Usability

We also rated system features and checked how easy the PCs were to set up and upgrade. In coming up with our Features ratings, we rewarded system characteristics that differentiate these topnotch Pentium Pro workstations from each other. Length and completeness of the warranty, number of slots and drive bays free for expansion, built-in security, and amount of dedicated graphics memory to support high screen resolutions (1600 by 1200 pixels) all contributed to better ratings.

For usability, a screwless design that makes it easy to remove the case and install an adapter card is a plus, as are clearly labeled I/O ports. On the other hand, an obstructed expansion slot is a minus. We gave extra points to systems that came with clear, well-indexed documentation. We consider adequately detailed jumper and DIP switch settings to be particularly important.

Evaluations in this report represent the judgment of BYTE editors, based on tests conducted by NSTL, Inc., as documented in a recent issue of their monthly PC Digest. To purchase a copy of the full report, contact NSTL at 625 Ridge Pike, Conshohocken, PA 19428; (610) 941-9600; fax (610) 941-9950; on the Internet, editors@nstl.com. For a subscription, call (800) 257-9402. BYTE Magazine and NSTL are both operating units of the McGraw-Hill Companies.

PENTIUM PRO WORKSTATIONS FEATURES

	OptiPlex GXpro 200	Digital Equipment Corp. Personal Workstation 200i	Hewlett-Packard Co. Vectra XU 6/200
Price as tested (MSRP) with monitor	\$6685	\$5834	\$9206
Overall rating	8.2	8.2	7.7
Performance	8.3	8.3	7.8
eatures	7.9	7.4	6.4
Isability	8.2	7.9	9.5
MICROPROCESSOR Manufacturer and model	Intel Pentium Pro 200	Intel Pentium Pro 200	Intel Pentium Pro 200
Secondary cache RAM per CPU (KB)	512	256	256
Number of processors/maximum number of processors	2/2	2/2	2/2
BIOS vendor and version	Phoenix A01	Phoenix 4.05	Hewlett-Packard
MEMORY			Decomposed and the second seco
Standard/as tested/maximum (MB)	32/64/128	32/64/512	32/64/256
Package type	DIMM	SIMM	DIMM
Speed (nanoseconds)	60	60	60
CC	V	V	/
Memory architecture	EDO	EDO	Fast-paged
MASS STORAGE	and the same of the same	2	
Hard drive manufacturer and model number (capacity)	Seagate ST32140A (2-GB)	Seagate ST32550W (2-GB)	Seagate ST32550N (2-GB)
Hard drive interface	Integrated Intel PCI EIDE	Adaptec PCI Fast/Wide SCSI-2 card	Integrated AMD PCI Fast SCSI-2
Standard 31/-inch floppy drive	V	V	V
Standard 5%-inch floppy drive	DINEC ADAD OF FIRE	O. TLib. VMCCOOD DW DIDE	A C COLLEGE FIRE
CD-ROM drive speed, manufacturer and model, interface	8x NEC A310-00, EIDE	8x Toshiba XM5602B-FW, EIDE	4x Sony CDU-76S, EIDE
ORIVE BAYS Total 3%-inch/5%-inch	3/2	3/3	4/3
Total 3%-inch/5%-inch with external access	3/0	1/3	2/3
Available 3%-inch/5%-inch	2/0	2/2	2/2
	210	212	2/2
GRAPHICS	Number Nine Imenine 100 Series 9 DCI	Matrox MGA Millennium PCI	Material MCA Miller Pice DCI
Graphics manufacturer and model	Number Nine Imagine 128 Series 2 PCI		Matrox MGA Millennium PCI
Maximum noninterlaced display resolution (refresh rate)	1600×1200 (83 Hz)	1600 × 1200 (72 Hz)	1600×1200 (72 Hz)
Color depth at maximum noninterlaced display resolution (bits)	16	8	8
Standard graphics memory/as tested/maximum (MB)	0.5/4/4	2/2/8	2/2/8
MONITOR Manufacturer and model	17-inch Dell 17 LS	17-inch Digital SN-PCXAV-YZ	17-inch Hewlett-Packard Ultra VGA 1280
Dot pitch (mm)	0.28	0.26	0.28
Maximum noninterlaced display resolution (refresh rate)	1280×1024 (60 Hz)	1280×1024 (75 Hz)	1280×1024 (75 Hz)
EXPANSION SLOTS			
Number of PCI/ISA (shared)	5/2 (2 shared)	3/3 (1 shared)	3/2 (1 shared)
Number of slots used	2	2	2
		2	2
/O Serial/enhanced parallel	2/1	2/1	2/1
Rated throughput of serial port(s)	115.2 Kbps	115.2 Kbps	115.2 Kbps
JART compatibility	16550	16550	16550
ntegrated EIDE	V	V	~
Jniversal Serial Bus (USB) ports	0	2	0
ntegrated Fast SCSI-2	0	2	~
0Base-T Ethernet	Integrated	Integrated	Card
POWER SUPPLY		SKI	
Output rating (Watts)	230	300	160
AC voltage (V)	110/220	120/240	110/220
Autodetecting/autoswitching	V		
Energy Star compliant	V		
DIMENSIONS			
- IIIILIIOIOIIO	6.5×16.5×17.6	16×8.5×17.5	16.4×8.3×15.9
Height × width × depth (inches)	30	21	33
			В
Veight (pounds)		В	
Weight (pounds) CC rating	B pending	В	
Weight (pounds) -CC rating CUSTOMER SUPPORT	B pending		
Weight (pounds) CC rating CUSTOMER SUPPORT Warranty length (years)/coverage	B pending 3/P,L,F,R	3/P,F	3/P,L,R
Weight (pounds) FCC rating CUSTOMER SUPPORT Warranty length (years)/coverage Phone	B pending 3/P,L,F,R Call local Deli dealer	3/P,F Call local Digital Equipment dealer	3/P,L,R Call local Hewlett-Packard dealer
Height × width × depth (inches) Weight (pounds) FCC rating CUSTOMER SUPPORT Warranty length (years)/coverage Phone Toll-free phone On-line address	B pending 3/P,L,F,R	3/P,F	3/P,L,R



✓ = yes

Warranty: P=parts; L=labor; F=freight to repair center; R=return to customer.

IBM Personal	Computer Co.	Polywell Computers, Inc. Poly P6-200ND2	SAG Electronics STF 3000	Xi Computer Corp. Xi Pro400 Mtower DP	Xi Computer Corp. Xi Pro400 Ntower DP
\$7081		\$5270	\$5650	\$4688	\$4788
8.0		8.2	7.9	7.3	7.9
8.1		8.3	8.0	7.3	7.9
7.2		7.4	7.3	6.5	6.7
8.7		7.5	7.4	6.8	8.4
Intel Pentium Pro	200	Intel Pentium Pro 200	Intel Pentium Pro 200	Intel Pentium Pro 200	Intel Pentium Pro 200
256	200	256	256	256	256
2/2		2/2	2/2	2/2	2/2
	4714	AMI 3.0.6			
IBM Flash Level	17A	AMI 3.0.6	AMI 1.01 Beta	Award 4,51 PG	Award 4.51 PG
32/64/512		64/64/1024	64/ 64 /512	32/64/1024	32/64/1024
DIMM		SIMM	DIMM	SIMM	SIMM
60		60	60	60	60
~		V	7	V	/
EDO		EDO	EDO	EDO	EDO
		r calama - care an			
IBM Starfire SX-I Adaptec PCI Ultr	AND DESCRIPTION OF THE PERSON	Seagate ST15150W (4.3-GB) Adaptec PCI Fast/Wide SCSI-2 card	Seagate ST19171W (9.1-GB) Integrated Adaptec PCI Ultra Wide SCSI	Quantum Fireball 3200AT (3.2 GB) Integrated Standard Micro Systems PCI EIDE	IBM 32160 (2.25 GB) NCR PCI Fast/Wide SCSI-2 card
~		V	V	V	V
		THE RESERVE OF THE PARTY OF THE	V		
6x Panasonic LF-	1195, EIDE	6x Toshiba 3701B, EIDE	8x Plextor PX-83CS, SCSI	8x Goldstar GCD-R580B, EIDE	8x Goldstar GCD-R580B, EIDE
3/2		0/10	3/3	4/3	2/8
1/2		0/8	2/1	2/3	2/5
2/0		0/7	2/2	2/2	1/6
Matrox MGA Mille	ennium PCI	Diamond Stealth 64 PCI	Number Nine Imagine 128 Series 2 PCI	Matrox MGA Millennium PCI	Matrox MGA Millennium PCI
1600×1280 (85	(Hz)	1280×1024 (65 Hz)	1600×1200 (83 Hz)	1600×1280 (80 Hz)	1600×1280 (80 Hz)
16	1.00%)	8	16	16	16
4/4/8		2/2/4	4/4/8	2/4/8	2/4/8
17-inch IBM P70		17-inch Sampo 17MX	17-inch Princeton Graphics EO75	17-inch ViewSonic Optiquest V775	17-inch ViewSonic Optiquest V77
0.26		0,28	0.26	0.26	0.26
1280×1024 (60	Hz)	1280×1024 (60 Hz)	1600×1280 (75 Hz)	1600×1280 (60 Hz)	1600×1280 (60 Hz)
5/3 (3 shared)		4/4 (none shared)	3/1 (none shared)	5/3 (1 shared)	5/3 (1 shared)
2		2	1	3	3
1/1		2/1	2/1	2/1	2/1
115.2 Kbps		115.2 Kbps	115.2 Kbps	115.2 Kbps	115.2 Kbps
16550		16550	16550	16550	16550
~		V	V	V	~
1		2	1	2	2
			/		
None		None	Integrated	None	None
200		300	230	235	300
115/230		110/240	115/240	110/220	110/220
12 4 4 19 19 E		V	V	/	
6.3×16.5×17.9		24×7.5×22.5	19.8×7.5×17	20×7.8×17	29×8.8×17.8
28		70	40	20	35
В		В	В	A	A
9/DI ED		O/DD:E/I D	n/DI ED	2/DI ED	2/DI ED
3/P,L,F,R	otos	3/P,R;5/L,R	2/P,L,F,R	3/P,L,F,R	3/P,L,F,R
Call local IBM de		(415) 583-7222	(508) 683-0339	(714) 498-0858	(714) 498-0858
(800) 426-2968		(800) 300-7659	(800) 989-3475	(800) 432-0486	(800) 432-0486
http://www.pc.ib	m	http://www.polywell.com	http://www.sagelec.com	http://www.xicomputer.com	http://www.xicomputer.com
1014		1015	1016	1017	1018

Lab Report

NSTL tests four remarkable packages for creating mixed-media hits. By David Seachrist

How Multimedia Multitools Compare

utting on a multimedia presentation used to be a real bear. But computer-based multimedia has changed all that. Everything is virtual.

We found the leading edge in four tools on the high end of the scale, all multimedia authoring packages that run under Windows 95 (though some are 16-bit and some are 32-bit): Macromedia's Authorware Interactive Studio 3.5 (hereinafter Authorware), Aimtech's IconAuthor 7.0, Innovus's Multimedia 2.1, and Asymetrix's ToolBook II Instructor 5.0.

As an all-around package for creating our test applications—a computer-based training (CBT) program and a kiosk program—ToolBook II Instructor offers the best balance of usability and flexibility. It comes with the most complete set of tools for developing and managing tests, offers a bevy of learning aids (including wizards and templates), provides the easiest integration of database information, and supports program distribution like no other product. Also, it's the best Web-enabled multimedia authoring tool for distributing CBT material via the Internet.

Macromedia is almost synonymous with multimedia, and its Authorware package is still the one to beat for producing games and other audiovisual-intensive material. However, for the test CBT and kiosk applications we created, the program's flowchart interface was less satisfactory than ToolBook II's screen-based approach. Authorware simply doesn't do as much to automate making tests and accessing databases.

The new kid on the block, Innovus

Multimedia, is impressive. Unlike many authoring tools, it isn't designed to create eye-popping audio and video extravaganzas. Innovus says the program is for "business multimedia." It's best used as a kind of programmable, interactive, super PowerPoint. The time-line view is helpful, and its scripting language—compatible with Visual Basic for Applications (VBA)—will be of interest to many people working in corporate environments.

BYTE BEST

AUTHORING TOOLS

Asymetrix's ToolBook II Instructor 5.0

comes with the most complete testing tools and a bevy of learning aids. It integrates database information most easily and supports program distribution features like no other.

But the package's learning aids and testwriting tools aren't as complete as Tool-Book II's. The next version's Rich Text Format (RTF) import facility and Internet support will be key enhancements.

Despite its power and many useful mini-applications, IconAuthor's interface, database connectivity, and tools for formulating tests are more difficult to learn and use than ToolBook II's or Innovus Multimedia's. But if you want to develop native OS/2 applications, IconAuthor is the only game in town.

How We Tested

We modeled our tests on typical multimedia projects likely to be encountered in corporate and academic environments. Our target user is someone with basic knowledge of business software but no experience in writing program code. Because these tools can be used to build a vast range of applications, our ratings would likely change if the test application had been, for example, a computer game.

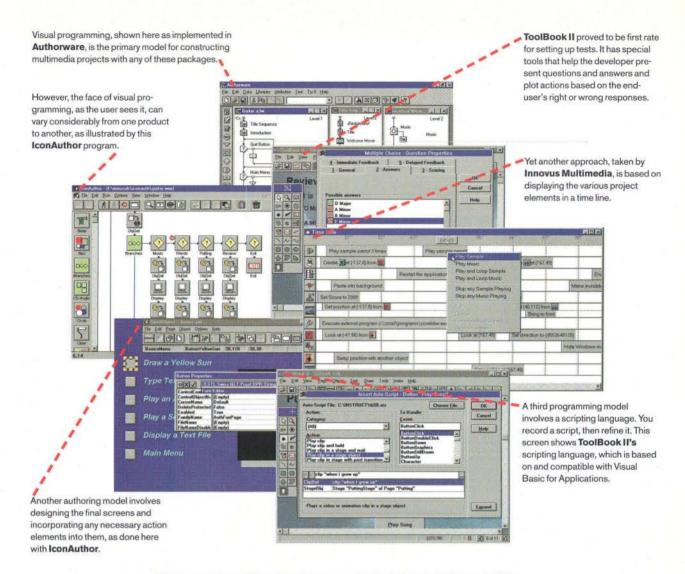
With each product, we created two applications. One was a CBT program designed to teach the user to play a song on the guitar; the program includes text, graphics, sound, digital video, and a test. The second program was an information-kiosk application tied to a real estate database.

We've evaluated these authoring tools primarily on the basis of their ease of learning and ease of use. Performance isn't a big issue with authoring software; speed of operation isn't as important as speed and ease of creation, and the time needed to add or import files into an application is minimal compared to the time needed to construct and check program logic.

Our testers needed approximately two days to learn the programs and create the two test applications with Authorware and IconAuthor. They needed one day with Innovus Multimedia and ToolBook II Instructor.

Structure or Content?

The heart of any authoring process is applying structure to content. You need both subject matter and a logical way to present it. For multimedia authoring, it's especially handy to be able to view both the structure and the content of a project.



Name your multimedia programming style and it's probably supported by one of these versatile tools.

In fact, each of the four tested programs offers at least two authoring modes. One mode is organizational and provides a top-down view of the components in an application by showing their sequence and relationship to one another. A second mode lets you see how a screen will actually be displayed. Innovus Multimedia also offers a time-line view that shows graphically the timing of all the events and objects tied to a given screen. We found this especially helpful in creating a screen that plays a sound file and a video file.

Authorware, IconAuthor, and Innovus Multimedia all use a visual flowchart for structuring applications. ToolBook II uses an object browser to view component hierarchies; its organizing principle is that of a book with chapters and pages. In constructing the CBT application, we found that Authorware and IconAuthor lend themselves to creating structure first and then adding content. Innovus Multimedia and ToolBook, on the other hand, are better suited to starting with the content and developing screens on-the-fly.

All the packages allow you to create applications using visual programming techniques, though the emphasis varies from program to program. Authorware and IconAuthor, for example, offer onscreen icons that work like elements of an electronic flowchart. To add a bit of programming logic to an application, you drag

an icon that represents the desired programming construct into the flowchart area of the screen. Authorware in particular rewards those who plan their text ahead. But as the project grows longer and more complicated, you have to consolidate the individual programming construct icons into compound icons, making it harder to maintain the bird's-eye view of the application.

ToolBook II's visual programming emphasis is on screen design. Making a button to play a video involves selecting a button tool, much as you would draw with a rectangle tool in an illustration program. After creating the button, you select menu options in order to assign properties that

**** Very Good

U M Α U M **BEST OVERALL** Multiple Choice - Question Properties Asymetrix ToolBook II Instructor 5.0 5 - Delayed Feedback ToolBook II balances usability and flexibility with a wealth of construction 2 - Answers 1 - General 3 - Scoring OK and management tools, learning aids, and integrated Web features. PRICE (NEW/UPGRADE) IMPLEMENTATION TECHNOLOGY USABILITY **OVERALL VALUE** \$1995 ToolBook II Instructor 5.0 **** Authorware Interactive Studio 3.5 \$4995/\$595 *** **** *** **** IconAuthor 7 \$1295/\$895

define how the button will work.

Innovus Multimedia 2.1

**** Outstanding

All four programs offer strong features for application development and programming constructs, including the ability to create and evaluate variables, build looping and branching structures, accept and evaluate user input, and provide feedback. The powerful scripting languages in ToolBook II, Authorware, and Innovus Multimedia give these programs an advantage in a corporate environment with skilled programmers. Innovus's script language is compatible with VBA, and Tool-Book II allows access to VBX controls to extend its power. All four programs support OLE, but only Authorware and Innovus currently support OLE 1.0 and 2.0.

Text in Context

Although "multimedia" conjures images of splashy graphics, sound, and video, text remains the fundamental means of communication. Any authoring tool worth its salt must provide flexible and easy-to-use text tools. The text editing environments in all four programs will seem below par compared to today's word processors. For example, Innovus Multimedia won't let you italicize just one word in a block, and you have to edit a block of text in a dialog rather than directly on-screen. IconAuthor's text editing is also less fluid than other aspects of the program.

Still, these packages are primarily for combining content, not creating it. Each one can import text, so you would normally edit and format screen text in with your word processor, then import it into the authoring program. With Innovus Multimedia, you can't currently import RTF files, just straight ASCII text, which doesn't maintain formatting attributes like bold type and character size. The next version, due out in November, will contain an RTF import capability.

Authorware offers the best text import, with the option to interpret page breaks as new screens. This really saves time when designing screens with lots of text. Innovus allows a similar option with straight text files, but the files require careful formatting with tabs, not page breaks.

* Poor

Graphics and AV Tools

\$495/\$150

*** Good

All four tools are good for creating, manipulating, and importing graphics. We did find that Authorware doesn't import JPEG graphics, and ToolBook II initially threw us for a loop until we learned that it loads JPEGs through its resource manager rather than through its graphic import option.

The relatively modest use of video and

audio in our CBT test application didn't challenge any of these tools. It was easy to attach sound files of guitar chords to the JPEG photos of the chords being played and to attach AVI (Video for Windows) files for video of the song being played. The only tricky element was synchronizing the video playback with the sound file. But all the programs control playback speed and can start and stop audio and video files easily.

Authorware has the most extensive audiovisual tool set, mainly because Macromedia bundles Director and Sound-Forge with it. But its tools are really geared toward building an audiovisual production, not the kind of application our tests focused on. You can make drawn objects

TECH FOCUS

DATABASE

Making the Data Connection

Many types of multimedia applications—encyclopedias, kiosks, even some games—depend on sophisticated databases. For these applications, a tool that supports database access is a necessity. All the products we tested offer some form of database support, but they vary drastically in how easy these functions are to use.

ToolBook II Instructor was by far the easiest for adding a database to our kiosk application. ToolBook has a database utility that parses database files and automatically creates a database front end with fields, labels, and browsing buttons. Unfortunately, what ToolBook gains in ease it loses in flexibility because dBase and Paradox are the only two file formats it supports. The other three programs are all compliant with Open Database Connectivity (ODBC) and support many database formats through the Microsoft ODBC driver.

Of these three, Innovus Multimedia was the easiest to use to add the database to the kiosk. It aids in formatting the screen by adding the field placeholders and record navigation buttons. In both Authorware and IconAuthor, the application designer has to add the proper field placeholders, labels, and record navigation buttons manually and individually. The process lacks the automation found in Innovus Multimedia.

Authorware's tutorial material for creating a kiosk application is less than satisfactory. The program comes with a sample application describing how to set up connections to various database formats and a booklet on connecting to databases using Microsoft's ODBC driver. But to succeed in using a database with an Authorware-constructed project, you will need a working knowledge of database structures and SQL statements. There are no automated tools to help here.

move in a designated path (path animation), and you can create simple cel (frame-by-frame) animations. Although Tool-Book's animation and video tools aren't as complete as Authorware's, the program offers ancillary video capture and editing software at minimal additional cost.

Testing

ToolBook II is the environment of choice for creating courseware, although a thirdparty course management package is available at extra charge for Authorware. ToolBook II lets you develop interactive tests that use a wide variety of predefined question types (multiple choice, true/false, etc.). Its course management system allows an administrator to track students' progress and test scores. Design tasks-specifying correct and incorrect answers, answer feedback, and scoringare all properties of question objects that the application designer can set from a single tabbed dialog box. This was by far the easiest approach to learn and use. Innovus Multimedia has question objects, but with fewer options. Authorware and IconAuthor have programming constructs to facilitate formulating test questions but lack the others' easy, object-oriented interface.

Program Distribution

Once an application is finished, it's time to distribute it. Authoring tools that can save programs as EXE files, easily manage resources (such as digital video, sound files, and drivers), and add an installation program can simplify this job.

All four packages let you freely distribute run-time players. IconAuthor, Innovus Multimedia, and ToolBook II have distribution programs that let you manage program resources and create floppy disk sets complete with an installation program. ToolBook II and Authorware allow you to save your programs as executables, so you don't need a run-time player. All in all, the packaging capabilities of ToolBook II and Innovus Multimedia are more complete than Authorware and easier to learn and use than IconAuthor.

Platform Support

Authorware is the only program we tested that runs as an authoring and playback application under both Windows and the Mac OS. IconAuthor offers OS/2 authoring and playback capabilities in addition to Windows support. Authorware and

	Authorware	IconAuthor	Innovus	ToolBook II
			Multimedi	a
GENERAL FEATURES	Classical	Classichent	Chambrid	Dest/Dess
Authoring metaphor Built-in database	Flowchart	Flowchart	Flowchart	Book/Page
ODBC support	~	~	~	
ncludes screen/page layout templates		Address of the last of the las	-	
Training/course management	(A)			V
CROSS-PLATFORM COMPATIBILITY				
Windows 95: Authoring, playback	~	16-bit	~	16-bit
Windows 3.1: Authoring, playback	V	~	V	~
Macintosh: Authoring	~			1120
Macintosh: Playback	V	Future		Via Web
OS/2: Authoring, playback		~		Web playback
Windows NT: Authoring, playback	V	16-bit	V	16-bit
Jnix: Authoring, playback		Future		Web playback
APPLICATION DEVELOPMENT			de di i	
OLE 1.0 and 2.0 support	~	OLE 1.0	~	OLE 1.0
/BX support				V
Scripting language	V		V-	~
Script recorder	~			~
WYSIWYG structure/screen design	~	~	~	screen only
Hypertext, hypermedia links,	~	~	-	~
event handling		~		
Assign procedures to screen controls Program flow statements	(B)	(B)	~	2
ntegrated debugging environment	(D)	(D)	-	-
TEXT TOOLS mport RTF and ASCII files	~	~	(C)	~
Search and replace	-	~	(C)	~
Text search and retrieval tools	-		(D)	~
DRAWING AND IMAGE TOOLS				
Number of graphics formats imported	7	34	14	20
Pen, line, rectangle, oval tools,	~	V	V	~
nap-to grid				All Street
mage manipulation	V	~		~
Graphics object manipulation	V	~	~	~
commands				
Clipart and tools included	~	~	~	~
ANIMATION AND VIDEO TOOLS				
Number of animation/movie	5	7	5	6
ormats imported				
Path, frame-by-frame animation	~	~	~	/
Automatic, polymorphic in-betweening Animate text	1			~
fideo capture and editing tools		~	~	extra cost
fideo control tools	-	~	-	extra cost
Fransition effects (fades, wipes, etc.)	-	~	-	~
AUDIO TOOLS		A CONTRACTOR OF THE CONTRACTOR		-
Number of sound formats imported	3	3	3	3
Sound synchronization	~	~	~	~
Control sound speed, duration,	~	~	~	~
sequence				
NTERNET AND DEPLOYMENT TO	DLS	Transfer of the		
Package to Web server	~	~		~
Save to HTML and Java				V
TP utility to transfer files to Web server	~	~		~
Can be run from Web browser using	V	~		~
player software or plug-in		and the last of		
Network deployment	~	V.	-	~
ree run-time player	~	V		V
Oreate distribution disks with nstall program		-		-
in the second se	-			V
Create stand-alone executables	V			
Create stand-alone executables / = Yes	~			

C=Import ASCII (*.txt) files; RTF files supported via a separate RTF editor included with the authoring software.

D = Available in script editor environment

New Products, New Properties, New Prices

The range and number of multimedia authoring tools is expanding at an amazing rate. When NSTL started this evaluation a few months ago, none of the programs in this report were available for under \$1000, and two were priced at \$5000. But since then, several vendors have changed their pricing drastically. Authorware is the only program that remains at \$5000; rather than reduce price, Macromedia decided to add value by bundling Macromedia Director, Extreme 3D, SoundForge XP, and xRes with the product.

Several other programs were outside our focus or arrived too late for inclusion in this review. While we didn't put them through the rigors of our testing program, they are packages worth considering.

Corel Click & Create 2.0

This international production (a U.K. product sold by a Canadian company) is aimed at a variety of multimedia developers and uses. The \$695 package (\$249 update) uses a storyboard paradigm, makes

heavy use of drag-and-drop editing, and supports DirectX video, WinG, ODBC databases, QuickTime, and Rich Text Format. As with most Corel applications, it comes with hundreds of fonts, clipart, animation files, and video clips (on two CD-ROMs).

mTropolis 1.1

A heavy-duty performer from mFactory, this program lets you build applications out of reusable objects. It's intended primarily for designing commercial CD-ROMs and Internet presentations. It relies heavily on its

scripting language, which is extensible. With mTropolis, you create your multimedia program once and can then deploy it on the Macintosh (68K and PowerMac) and on Windows 3.1 and 95 platforms. Cost is \$1195.

Oracle Media Objects 1.1

Oracle's entry, as you might expect, readily connects to Oracle databases and is focused heavily on entertainment and interactive broadcast production as well as corporate communications and training. With this product, you can build your program on either a Windows machine or a Macintosh, then play it back on either platform or—tada!— Apple's forthcoming set-top box. With that addition, as well as Oracle's commitment to Web computers, this \$495 package may become an important player in the multimedia market.

PowerMedia 2.0

RadMedia's authoring package is a good bet if you don't need data-

base support (though the company promises that for the future). What your \$495 buys now is a storyboarding environment that enables easy Web distribution with one-click hyperlinking and generating of Hypertext Markup Language files. You also get hundreds of screen layout templates; good support for a wide variety of graphics, video, and audio imports; an image editor; and illustration tools. This will be of interest to people developing educational courseware, Internet advertising, entertainment titles, and corporate communications.



Corel's Click and Create, with its time line and storyboard, is especially versatile.

Innovus Multimedia run as 32-bit applications under Windows 95.

But platform-specific support becomes less critical as the World Wide Web grows in popularity. Already, ToolBook II is powerfully Web-enabled; it can save applications in Hypertext Markup Language

(HTML) and Java formats, has a browser plug-in, and offers templates for building applications distributed via the Web. Authorware also offers a browser plug-in, and end-users can configure Authorware and IconAuthor run-times as helper applications. Innovus Multimedia plans Inter-

net capabilities for the next version, due out in November.

In the final analysis, ToolBook II is our top pick because it does the best job of balancing ease of use with a rich set of features. Innovus Multimedia, which takes a minimalist, PowerPoint-like approach, would be our second choice, especially for developing simple presentations.

David Seachrist has tested software for NSTL for 10 years, concentrating on desktop publishing and graphics. You can reach him at dseachrist@prodigy.com.

Evaluations in this report represent the judgment of BYTE technical editors, based in part on extensive tests conducted by National Software Testing Labs, as documented in a recent issue of NSTL's monthly Software Digest. To purchase a copy of that report, with NSTL's own evaluations and data, contact NSTL at 625 Ridge Pike, Conshohocken, PA 19428; (610) 941-9600; fax (610) 941-9950; editors@nstl.com. For a subscription, call (800) 257-9402. BYTE Magazine and NSTL are both operating units of The McGraw-Hill Companies.

PRODUCT INFORMATION

Authorware 3.5 \$4995 (\$595 upgrade) (486, 8 MB;16 MB recommended) Macromedia San Francisco, CA (800) 326-2128 (415) 252-2000 fax: (415) 626-0554 http://www.macromedia.com Circle 1022 on Inquiry Card.

IconAuthor 7.0 \$1295 (\$895 upgrade) (486, 8 MB;16 MB recommended) Aimtech Nashua, NH (800) 289-2884 (603) 883-0220 fax: (603) 883-5582 http://www.aimtech.com Circle 1023 on Inquiry Card.

Innovus Multimedia 2.1 \$495 (\$150 upgrade) (486SX, 8 MB; 16 MB recommended) Innovus Salt Lake City, UT (800) 433-1806 (801) 463-8200 fax: (801) 484-9561 http://www.innovusmm.com Circle 1024 on Inquiry Card.

ToolBook II Instructor 5.0 \$1995 (386DX, 8 MB; 12 MB recommended) Asymetrix Bellevue, WA (206) 462-0501 fax: (206) 637-1650 http://www.asymetrix.com Circle 1025 on Inquiry Card.

Corel Click and Create 2.0 \$695 (upgrade \$249) Corel Ottawa, Ontario, Canada (613) 728-8200 http://www.corel.com Circle 1026 on Inquiry Card. mTropolis 1.0 \$1195 mFactory Burlingame, CA (415) 548–0600 http://www.mfactory.com Circle 1027 on Inquiry Card.

Oracle Media Objects 1.1 \$495 Oracle Redwood Shores, CA (415) 506-7000 http://www.oracle.com Circle 1028 on Inquiry Card.

PowerMedia 2.0 \$495 RadMedia Palo Alto, CA (415) 617-9430 fax: (415) 473-6826 http://www.radmedia.com Circle 1029 on Inquiry Card.



If you think file transfer is all we do, you need some time away from the office.

To appreciate how much more LapLink® for Windows® 95 has to offer, all you have to do is hit the road.

Wherever you go-across the hall, across town or across the country-if you've got LapLink, you have everything you need to access anything you want on your desktop or your network.

With this single piece of software, you can read and send e-mail, run databases and custom applications, synchronize data and, yes, even transfer files.

Since there's no need to change apps to do all these things, there's no need to hang up and redial. And since LapLink works the same way over modems, IPX and TCP/IP networks, serial cables, parallel cables, wireless, even the Internet, there's no need to laboriously reconfigure.

And there's no need to worry about compatibility. Our 16-bit version is built right into LapLink for Windows 95, so connecting to Windows 3.1 systems is no problem at all.

By now, you probably can't wait to get your hands on the latest LapLink. So you'll be glad to know that upgrading—from an earlier LapLink, or from another product altogether—is ridiculously inexpensive. Call 800-224-7704. Better yet, see your reseller. It'll give you an excuse to get away from the office.



- world Wide Wait

Genuine, truly personalized, intelligent agent technology

for the 'Net is here.

Some have promised but have they delivered?

Now, whether you're a consumer, service provider, content publisher... whatever your view of the 'Net - imagine what Autonomy agentware could do for you.

This time it's personal.

real intelligent agents are here Owww.agentware.com



Circle 207 on Inquiry Card (RESELLERS) 208

Neb Projec



On-Line Componentware software component.

I use AltaVista to build BYTE's Metasearch application and realize that every Web site is a

oftware components can turn up in the unlikeliest places. In our May 1994 cover story ("Componentware," http:// www.byte.com/art/9405/sec5/sec5.htm), for instance, we pointed out that objectoriented programming (OOP) technology had failed to produce a rich harvest of plug-and-play software objects. However, we showed that Visual Basic custom control (VBX) technology-a hastily conceived mechanism for Visual Basic plugins-had, to everyone's surprise, jumpstarted a thriving component-software industry.

Fast-forward to 1996. I want to prototype a Web-search application that embraces BYTE and five fellow McGraw-Hill publications. I have only a few hours to spend on the task. What component can I pull off the shelf and use? Java or ActiveX components? They're coming, but they're not here yet. Distributable search engines? They exist, but deployment across six Web sites will take more than the allotted few hours.

As I drove home from work, I suddenly knew where to find the right component for the job. It was sitting in plain view at http://www.altavista.digital.com/. That's right—Digital Equipment's Alta-Vista, a public Web site, is also the software component that let me prototype the McGraw-Hill Metasearch application before I went to bed that night.

A powerful capability for ad hoc distributed computing arises naturally from the architecture of the Web. This month's column demonstrates that fact, in a compelling way, using AltaVista as an example. But the technique that I describe here applies equally to The BYTE Site or any public Web site. My intent is only to demonstrate the technique and consider how

Go to: dev4.byte.com/metasearch.pl

BYTE's McGraw-Hill Metasearch: isdn+near+internet

BYTE

May 1996 / International Features February 1996 / Cover Story / Toss Your TV February 1996 / Cover Story / Toss Your TV March 1994 / Cover Story / Building The Data High Way January 1995 / Special Report / The Virtual Storefront

Data Communications

Network Software Internet Watch The 1996 Data Comm Market Forecast Stop Singing Those Blues International Network Services Browse by Subject/Technology

BusinessWeek

SCIENCE & TECHNOLOGY -- 01/29/96 SCIENCE & TECHNOLOGY/1 -- 01/29/96

UnixWorld Online

UnixWorld Online: Hardware Review; No. 001

Powered by AltaVista

Document Done

In only a few hours, I created an application that intercepts AltaVista search results and groups them by site of origin.

it enables large-scale software componentry. For commercial-grade solutions that leverage AltaVista, check out the AltaVista Business Extensions at http:// altavista.software.digital.com/sitemap/ nfbusexten.htm.

Web Site as Software Component

Brad Allen, who created Quarterdeck's WebCompass, first showed me how a Web site can work as a software component. At Fall Comdex in 1995, he plugged The BYTE Site into WebCompass and showed how Quarterdeck's product could add value to our site's native search function. How was this possible? If there is a telnet on your system, try doing this experiment:

telnet www.byte.com 80 get /

The above sequence transmits an HTTP GET request to the BYTE Web server and then asks for the server's root document. What telnet subsequently spews forth will be the Hypertext Markup Language (HTML) source text of BYTE's home page.

Internet newcomers are often surprised to learn that the Web is built on such a simple mechanism. Old hands just take it for granted because they're familiar with other Internet applications that work the same way. For example, telnet to dev4.byte.com on port 119 and enter help to reveal the NNTP command set of BYTE's news server. And below is a way that you can query the BYTE archive and our Virtual Press Room for documents that contain references to NNTP:

telnet dev5.byte.com 80
get /cgi-bin/sw2.pl?keywords=
nntp&index=both

Like all Web sites that run scripts to generate pages, The BYTE Site has an implicit API. It's not documented, but it's easy to discover. Just run an interactive search

and then view the source of the results page. There you will see how the form variables keywords and index control the several search engines that are running on the site.

When you query interactively, those variables are transmitted by way of a temporary file using the HTTP POST method. However, an equivalent command line that uses the HTTP GET method, as shown above, works just as well.

A Naive Implementation of Metasearch

A little interactive experimentation with AltaVista revealed the API that I needed to call to implement Metasearch. I exploited AltaVista's fielded search capability to isolate a set of Web sites, like this:

q=host:www.byte.com+and+host: lantimes.com+and+nntp I couldn't expect users to telnet to Alta-Vista and type this junk. So my first naive implementation was a Web form that called a BYTE Site script that returned another form that called AltaVista.

Sound squirrelly? It was. I needed the first form to capture the search keywords, the script to interpolate the keywords into a Common Gateway Interface (CGI) request template, and the second form to present the final request to the user as an action that could be invoked via an HTML Submit button.

When Javascript and VBscript stablilize, they'll eliminate the need for many of these CGI gymnastics. Simple active-client technology could have streamlined my naive implementation. But if Metasearch did nothing more than point the user's browser at AltaVista, I'd still call it naive.

The finished application does more. It adds value by intercepting the results that

Getting Along with AltaVista

where the same as the one that humans use: uniform resource locators (URLs). Thus, you don't need to do anything special to make your site a pluggable Alta-Vista component.

Some Webmasters worry—with reason—that a robotic indexer will fetch too many pages too quickly and render a site unresponsive to normal users. That isn't a problem with AltaVista, which adapts dynamically to your site's ability to pump out pages. When I first heard about AltaVista last winter, I was amazed to learn it had already indexed our site.

Why the surprise? After a few other robots had applied heavy suction to our server, I added a "pig report" to my daily log processing. It highlights visitors who pull more than 1 percent of any day's pages. These high-volume customers are invariably Web crawlers. I like to keep track of who they are and how they use the data they vacuum out of my server.

But AltaVista never showed up on the pig report. Its inventor, Louis Monier, later explained why. Scooter, the AltaVista spider, measures the time it takes to fetch a page from each of the hundred-odd sites it visits concurrently. It multiplies that interval by what Monier calls a "good-guy factor" and waits that long between fetches. Thus, Scooter can concurrently fetch once per second from a major site on a T3 link, and once every 5 minutes from a minor site on a 28.8-Kbps dial-up link.

The Robot-Exclusion Standard

There's an API that can govern site/Webcrawler interaction. It's called the robot-exclusion standard, and your site implements it by placing directives into a file called robots.txt at the Web-server root. Here is the robots.txt file that I use on several

AltaVista's Altruism

Problem: Robotic indexers can clog your Web site by trying to fetch too many pages too quickly.

Solution: AltaVista's indexer, called Scooter, multiplies the time it takes to fetch a page by a "good-guy factor." Thus, Scooter dynamically adapts itself to each site's ability to send out pages.

Result: Scooter may call upon a major site with a T3 link to pump pages at a rate of one per second, while the rate for a site with a 28.8-Kbps link may be one every 5 minutes.

BYTE Site development servers to lock out robots completely:

User-agent: *
Disallow: /

Why? A few months back, I did an Alta-Vista search and turned up URLs pointing not only to http://www.byte.com, but also to a backup archive on one of my development servers. I checked its log and found that about 5 percent of the official site's traffic had diverted to the backup server. Worse, the archive was several months out of date.

How did this happen? I'd let a page on the official site include a pointer to an unrestricted subtree on the backup server. Scooter found the hole and jumped through. Yikes!

To prevent Inktomi and WebCrawler and the rest from following suit, I plugged the hole using access controls and (for good measure) robots.txt.But AltaVista to this day remembers these unofficial URLs, and there's no way I can make it forget them.

An ambitious fix would be to regenerate the archive on the backup server, substituting redirection headers for documents. My less ambitious fix was to lock down the backup server and rig it to tell people to look instead on http://www.byte.com. If you're one of those people, I apologize for allowing the sorcerer's apprentice to run amok. Learn from my mistakes and use robots.txt (along with regular access controls) to protect what you don't want to publish.

BUSINESS MULTIMEDIA: No, it's not an oxymoron. And Bill Gravinsky,

VB and C++ jock, knows it. Bill has redesigned the existing sales automation system to reduce errors and increase productivity of new in-house reps. His charter—develop a friendly

GUI, make it easy to update product and customer information over the

So Bill's using INNOVUS
Multimedia. Cool and useful-that's
business multimedia. Question is
what are you going to do with it?

done by Friday.

network-and have it



LL 1.888.301.7728 toll free A FREE CONTEST KIT & DEMO DISK

What are you going to do with it?



AltaVista returns and grouping them by site of origin (see the screen on page 129). You could achieve this effect using advanced active-client technology—a Java program or an appropriately scripted ActiveX control. Or, since these technologies are not yet widespread and stable, you could do it on the server side with conventional CGI techniques. Because I wanted to write the application in a few hours and know it would work on most installed browsers, I chose the latter approach.

Script Control

There are several Perl libraries that you can use to call uniform resource locators (URLs) from your own Perl scripts (see CPAN, the Comprehensive Perl Archive Network, at many URLs, including ftp://ftp.digital.com/pub/plan/perl/CPAN/). Two that I've tried are Roy Fielding's libwww-perl (http://www.ics.uci.edu/pub/arcadia/libwww-perl/) and Jim Richardson's Wire.pm (http://www.maths.usyd.edu.au: 8000/jmr/perl/PerlCode.html).

For arbitrary reasons, I used Wire.pm, but libwww-perl (or another equivalent package) would also have worked. With any of these, you can pass a URL to a library function that "calls" it and "returns" the resulting HTML document (or perhaps just an HTTP header), which you assign to a Perl string variable. Then you can use Perl's unparalleled string-handling power to analyze and act on the result page. When that page is program output, it will typically exhibit a regular, repeating structure. Parsing these kinds of pages is like shooting fish in a barrel.

There was one complication. Rather than issuing a single request that combines all the Web sites that are checked on the form, Metaseach instead issues one request per site. Why? AltaVista chunks its results across a series of pages that must be fetched sequentially. A search that pro-

TOOLWATCH



QuickDNS Pro \$290

Men and Mice Reykjavík, Iceland http://www .menandmice.com

Who says you need a Unix box to provide DNS service for your site? QuickDNS Pro does it very nicely on a Macintosh.

Plugging In the Linux Box

A few months back, analysis of the keywords used to search The BYTE Site revealed that Linux ranked fifth. Clearly, a lot of visitors knew something I didn't, and I resolved to find out what.

Today, a P150-based Dell running the Caldera distribution of Linux is an increasingly important pillar of The BYTE Site. All our conferences run there; INND supports newsreaders, and Apache provides an alternate Web-based view. I transfer files between Windows NT servers and Unix servers using Samba, a nifty SMB utility that makes the Linux server look like an NT peer file server.

And when I found that the key component of Metasearch (a Perl 5 module called Wire.pm) didn't like my NT Perl setup, I didn't waste time figuring out why. (A lot of Perl tools, though in principle are portable, in practice work better with Unix.) It was easier to build and run Metasearch over on the Linux box, so I did.

What's delightful about Web development is that the components you build can float effort-lessly from one platform to another. NT and Unix offer complementary strengths. Exploit them both. And if you want to deploy a Unix system as part of the mix, Linux is a really useful one.

duces hits for all the selected sites often won't represent each of those sites on the first results page. That mandated a multirequest strategy.

One approach would be to thread a series of requests using the URL that's behind the Next link on every AltaVista result page. But how to decide when to stop? One query might yield a few result pages; another, dozens. So I opted for one page of results per selected site.

Doesn't that mean each site's results aren't fully enumerated? Yes. There are other problems, too. Metasearch is only as current as the most recent AltaVista visit to the sites I list. And it forces you to wait twice—once for AltaVista to return the results to The BYTE Site, and again for Metasearch to process them and return a final page to you.

Metasearch isn't a real solution. Some commercial-grade solutions are available from Digital, including one that will "custom crawl" a group of sites and maintain a separate index for that group. I describe Metasearch here only to show how the Web is transforming software development even more profoundly than it's transforming publishing.

A Web of Components

It should be clear to you now that you can use tools such as libwww-perl and Wire.pm to quite easily construct your own customized link checkers and Web spiders. Why bother? Well, I've tried a bunch of shareware and commercial link checkers, and none that I've found can integrate easily and well with my site-management procedures.

But spiders and link checkers merely

scratch the surface. Imagine a cousin to Metasearch called Metaorder, which would automatically spring into action when you ordered a subscription to BYTE using our site's order form. Metaorder might need to update four or five different databases in different locations around

BOOKNOTE

Where Wizards Stay Up Late: The Origins of the Internet

by Katie Hafner and Matthew Lyon Simon and Schuster

http://www.simonsays.com/

Tales from the sixties, when the Internet was just two tin cans and some string.

the world. Each of these databases might use a different engine and run on a different OS, but all could be available (behind layers of encryption and authentication) on the Web.

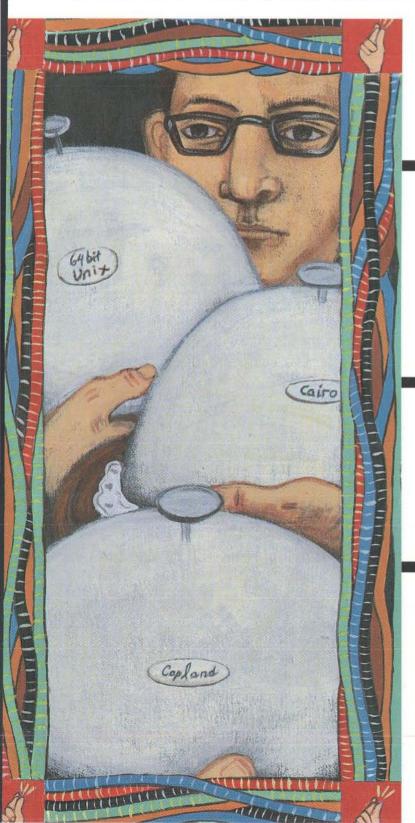
Metaorder could therefore orchestrate a heterogeneous two-phase commit. The "APIs" at each of the sites will have been built anyway to support browser-based interactive execution of these several tasks, per corporate intranet objectives. Once that's done, it shouldn't take 18 workermonths to prototype Metaorder. It should take a day.

Jon Udell is BYTE's executive editor for new media. You can contact him by sending e-mail to jon_u@dev5.byte.com.

OS Strategies



How to sort out the technical merits and shortcomings of tomorrow's versions of Unix, Windows NT, and Mac OS.



Your Next OS

Consider these six key issues before committing to a next-generation OS strategy.

Page 134

Unix Leads the 64-bit Charge

64-bit OSes can address massive amounts of memory. But where are the 64-bit applications?

Page 139

Unearthing Cairo

Cairo now may be a set of new features for Windows NT. Can it help Microsoft's enterprise push succeed?

Page 145

Copland, Revisited

Apple's upcoming OS offers new microkernel and hardware-abstraction services to compete with the other OSes. But when?

Page 151

YOUR NEXT OS

What to consider when evaluating next-generation operating systems.

By Dick Pountain

In this Special Report, we'll evaluate the next-generation implementations of three major OS platforms: Unix, with its continued enhancement of 64-bit architectures; Windows NT and the stops and starts of what has been known as Cairo; and Apple's Copland, which will arrive piecemeal over the coming months rather than as one integrated package.

Whether you're committed to one of these platforms or you're considering a switch to a different one, the decisions you make today will affect your OS strategy for years to come. How do you begin to evaluate tomorrow's operating systems? Start by analyzing six key areas.

ROBUSTNESS

An enterprise-level OS ought to run in protected mode and employ preemptive multitasking, so errant programs can be killed off without bringing down the OS itself. Windows NT and Unix both offer such protection now. However, some people are concerned about the robustness of the new kernel-mode graphics driver scheme in NT 4.0 (which will presumably persist in forthcoming versions) compared to the slower but safer scheme in earlier NT versions.

Copland still represents only a partial answer to Macintosh robustness. Copland's new microkernel runs applications, as far as possible, in protected memory, but it must allow kernel access from old applications to maintain System 7.x compatibility.

MULTIPROCESSING

What's driving the move to multiple CPUs? Partly the performance requirements of network servers; partly processing-intensive client-side applications, such as rendering 3-D graphics and calculating large spreadsheets. These applications don't require massively parallel supercomputers, just rather modest symmetrical multiprocessing (SMP) systems that use shared memory and an OS that automatically distributes multithreaded applications over different CPUs. NT already supports one to four processors, and machines like Intergraph's four-Pentium graphics PCs are exploiting NT's multiprocessing capabilities. At the same time, specialist vendors like Sequent run NT with up to 28

CPUs. The Cairo development effort worked at refining the existing thread-allocation algorithms to achieve better load balancing between the CPUs.

Apple desperately needs to provide SMP ability for Power Macs to keep its traditional high-end graphics users from defecting to NT to reduce rendering times. Copland will introduce SMP with the microkernel's Thread Manager, which can allocate threads to multiple CPUs. However, backward compatibility may constrain Copland's SMP abilities.

Unix has supported multiprocessing for years, and most massively parallel supercomputers run Unix-derived OSes. The main commercial Unix variants, such as SCO, Solaris, and Unix Ware, all support SMP, and such systems often run with up to 64 CPUs.

CONFIGURATION MANAGEMENT

Perhaps the greatest single disadvantage of PCs today is the nightmarish difficulty of maintaining large numbers of them. Every new peripheral requires new drivers, which get updated frequently. Current PC OSes offer little assistance to a system manager who has to install new drivers on hundreds of machines.

Mature software version control has become a critical issue. OS upgrades commonly overwrite—without asking—system DLLs with new versions that break existing software installations. The Windows 95/NT registry scheme, for example, is inadequate and should be strengthened or replaced. Copland will track software revisions with a service called Patch Manager.

Unix management has traditionally been a matter of maintaining many text-based configuration files, the contents of which are a mystery to all but the gurus. Windows NT and the Mac OS have the advantage of GUIs and interactive configuration utilities. Even so, the sheer number of PC peripherals vendors has made management more and more arduous. Hence

Plug and Play becomes vital, and its absence has stalled wider acceptance of Windows NT.

The Macintosh has long been blessed with true plug and play and easy configuration (possibly due to less nonproprietary hardware). But with the growth of a clone Mac market, this could become an issue. Copland's hardware abstraction scheme, which organizes device drivers into related families, will maintain some discipline while still allowing third-party vendors to differentiate their products.

NETWORK CONFIGURATION

As networks grow, an administrator must get help from the OS to remotely configure systems and share configuration changes. Windows NT centralizes user management onto a single primary domain controller. But if network growth requires multiple domains, it becomes a beast. Microsoft's plan is to organize mul-

support

Symmetric multiprocessing

Preemptive task scheduling

Automatic hardware detection

Per-process memory protection V

Protected-mode kernel

Multithreaded execution

Component architecture

Extensible OS kernel

64-bit address space

Fault-tolerant file system

tiple domains into a tree structure like that of archrival Novell's NetWare Directory Service (NDS). Future versions of NT will also support multiple master domain controllers, giving remote branch offices connected via WANs more independence while still maintaining system coherence. Microsoft also plans retooled directory services to simplify managing mixed networks by unifying log-in and administration procedures. The Open Directory Services Interface (ODSI) is intended to do for direc-

tory services what Open Database Connectivity (ODBC) does for database access: make it vendor-independent.

✓=yes

DISTRIBUTED OBJECTS

Unix vendors, under the Object Management Group (OMG), have spent several years on the Common Object Request Broker (CORBA) standard for different systems exchanging objects. OMG recently settled on Sun's Universal Networked Objects as the standard for remote interoperability and on OpenDoc as the compound document model for CORBA 2.0. This conflicts with Microsoft's own proprietary Distributed Common Object Model (DCOM) and ActiveX. To complicate matters, Sun's Java Component Architecture offers a way for Java components to talk across the Net. Sun's approach is backed by Netscape's 38 million copies of Navigator, which is ready to accept Java-based plug-ins. Netscape is cooperating with OMG to make Internet Interoperable ORB Protocol (IIOP) the unifying technology for Internet objects in all its future Web browsers.

This seems to have panicked Microsoft into a compromise: It will hand over its ActiveX object technology to a customer-driven open standards body (a first). So perhaps customer pressure might finally force a convergence of object standards.

64-BITNESS

Unix vendors worry how Microsoft and Apple plan to push Wintel and the Mac further into traditional Unix domains. The Unix

solution is to move up to 64-bit OSes (see "Unix Leads the 64-bit Charge" on page 139). Microsoft has only just started offering PC users a fully 32-bit OS: NT, not the 16-/32-bit hybrid that is Windows 95.

The main attraction of these next-generation OSes is that you can access more memory through 64-bit addressing. A 32-bit address space allows up to 4 GB of memory. Until recently, most users have regarded gigabyte memories as quite enough (if not pure fantasy), but the rise of client/server computing has us contemplating servers that cache huge databases entirely in RAM to speed up access rates. Gigabytes of memory suddenly makes sense as a giant disk cache. And a 64-bit address bus and OS can access up to 18 billion gigabytes.

Windows NT already runs on DEC's 64-bit Alpha chips. To push NT as a server OS, Microsoft needs to let Alpha users fully exploit its 64-bitness, or Unix may tempt them away. However,

64-bit Unix

Various

Rebuild

Some

OS Features Checklist

Copland

Not for

legacy code

OpenDoc

NT

V

ActiveX

the lack of 64-bit applications, plus Intel holding 64bit addressing for its nextgeneration Merced chip, means that this is not a top priority for Microsoft, or most of its users, just yet.

WHERE FROM HERE?

If you're a Unix user, you just have to choose when or if you'll move up to a 64-bit version. If you really need the huge address space of 64 bits, you probably already know it. Similarly, the question for a Macintosh user is not whether

you need Copland but rather how soon you can get it. If your graphics work involves high-resolution rendering, then you need the assistance of multiprocessing now. Because many Mac tools are being ported to NT, it's becoming a race: The longer Copland takes to deliver SMP, the more alluring are the cheaper hardware and existing SMP of NT.

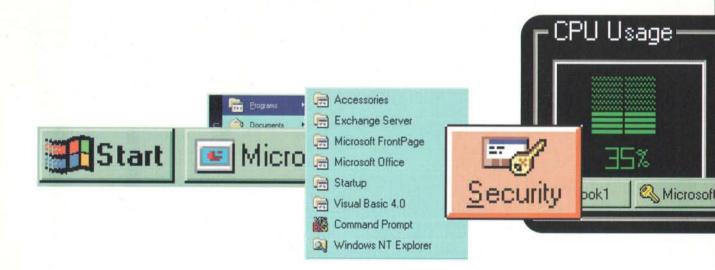
Windows users face the most uncertainty. For intranets, you could use NT, NetWare, or Unix for the server OS, and any of a dozen choices for your Web servers. Microsoft's new Internet orientation might affect your plans in several ways. The next NT shell—with integrated Internet Explorer—is currently in beta; it presents an "HTML everywhere" desktop that can display live Web pages. Even the Windows Help file format abdicates to Hypertext Markup Language. Visual Basic's current incarnation is temporary, as its forms engine is not based on HTML. Planning to invest in a hypertext or document management system that doesn't involve HTML? Think hard.

Most important, though, you must decide whether Microsoft can make the more ambitious features of the Cairo project work and, if so, when. OS developments are exciting to watch, but excitement may not be what you want when it comes time to making decisions. If you can do it, waiting for the dust to settle may be the best strategy for the next few months.

Dick Pountain is a long-time BYTE contributing editor who lives in London. You can reach him at dickp@bix.com.

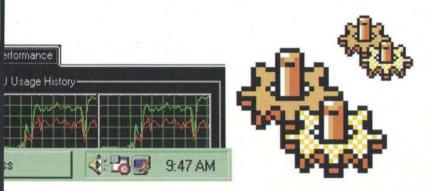
Microsoft Windows NT Workstation 4.0

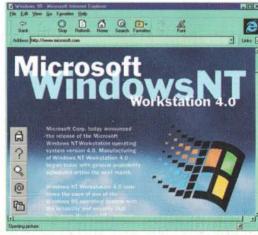
has the ease of It has the power



Windows 95. of Windows NT.

computers everywhere drooling.

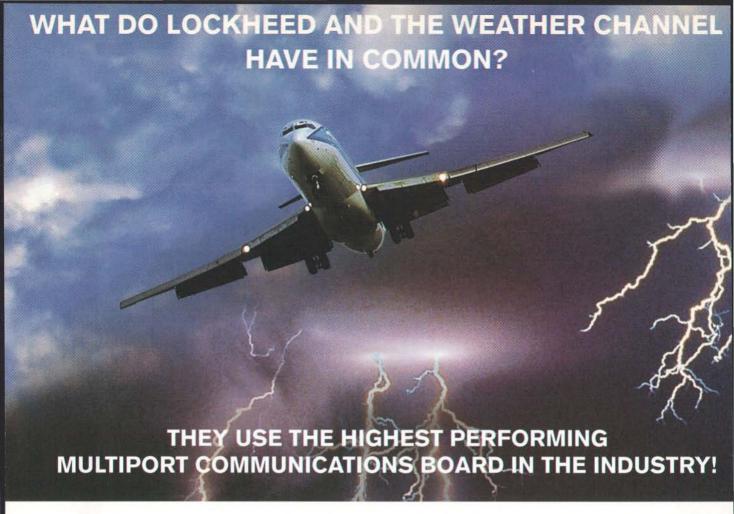




The new Windows NT® Workstation 4.0 operating system has been designed to be the most powerful desktop operating system. And because all that power is controlled by the Windows® 95 interface, it's much easier to use. The total 32-bit power of Windows NT Workstation means reliability, security, and easy access to the Internet and intranet. It's reliable because all applications run in their own memory space—so that new game beta won't crash last week's work. It's secure because integrated features let you lock your system all the way down to the file level, so you can count on applications and data being safe.

It's Internet-ready because it's loaded with built-in features like TCP/IP, the Microsoft Internet Explorer browser, and integrated Peer Web Services, which lets you create a small intranet for your workgroup. And because it's all controlled by the Windows 95 interface, you can customize your system to work and look however you like. So does all this mean Windows 95 is history? Absolutely not. Windows 95 may still be your best choice, depending on your existing hardware and applications. We suggest you dive headfirst into our Web site to compare and contrast operating systems to see which 32-bit desktop is best for you.

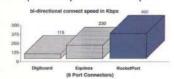




When these companies were looking for speed, reliability, affordability, and ease of use for remote access and peripheral control, they chose a Comtrol serial communications board.

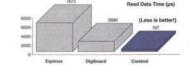
Comtrol's **RocketPort** is the industry's fastest controller. **Twice the speed of Digi's Acceleport**. This breakthrough performance is achieved by putting eight ports and a RISC processor onto one chip.

Using this technology, internet access speed can be increased 16x from 28.8 Kbps to 460 Kbps full duplex across all ports.



Comtrol's software drivers and technical support make it easy to switch. We provide drivers for Novell Netware Connect, Multiprotocol Routing, Windows NT RAS, UNIX,

OS/2, and Linux. If you are already using one of these drivers, all you need to do is install your **RocketPort** card. I/O mapping eliminates memory conflicts and allows plug and play compatibility. **RocketPort** also gives you **30 times faster** processing! This host CPU efficiency allows you to add more ports or free up valuable CPU time.



For your additional needs, our technical experts are just a phone call away to give you step-by-step instructions.

See for yourself! Call 1-800-926-6876, e-mail us at info@comtrol.com, or look us up on our website: http://www.comtrol.com. Comtrol provides a 5 year limited warranty and a 30 day risk free trial for all products.

Get the best board at half the cost and personalized support from the company that created the multiport industry in 1982 — the only company with 14 years of experience...Comtrol.

Circle 215 on Inquiry Card.











LLUSTRATION: MERYSA NICHOLS © 1996

Unix Leads the 64-bit Charge

64-bit OSes are moving from the horizon to your desktop. And you get the benefits.

By Laurent Lachal

omputer technologies march relentlessly to the rhythm of bigger and faster. CPU clock speeds, which once seemed fast at 33 MHz, now push past the 200-MHz mark. Similarly, OSes that gave us a speed boost with 16-bit architectures now are evolving to 64-bit technology to meet the demands of processor-hungry applications, such as data warehousing and virtu-

al reality (VR).

But if you're not setting up an on-line transactionprocessing (OLTP) server, how much can you really benefit from today's 64-bit versions of Unix or tomorrow's 64-bit Windows NT or Mac OS? In reality, the added capabilities of 64 bits are narrow in scope. The most significant changes affect process and file management and memory capacities. The 64-bit transition leaves reasonably untouched such aspects of OSes as concurrency (where multiple applications share resources), scheduling, and security.

The answer to how you can benefit from a 64-bit OS ultimately depends on what applications you are running, whether your hardware is tuned for 64 bits, and whether your system has the massive amounts of memory needed to take advantage of the architecture. In the end, the possible advantages of

64-bit technology come in shades of gray, not the relatively blackand-white distinction that defines the performance differences between 16- and 32-bit systems.

Faster Number Crunching

Process management benefits from 64-bit OSes because the OS kernel executes larger instructions that can do more processing

per cycle. The kernel can also manipulate 64-bit integers to give applications faster, more complex number-crunching abilities.

This increased processing capability goes hand in hand with an exponential growth in the memory (virtual and real) that's addressable by each process. A 64-bit memory space can now address a maximum RAM of 2⁶⁴ bits—or more than 18 billion

GB—compared to the mere 2³² bits (4 GB) possible for 32-bit OSes.

More and Larger Files

Virtual memory enables an application to use RAM as a disk cache. In turn, a larger disk cache is necessary with 64-bit OSes because not only can they handle a larger number of files, but they can accommodate much larger ones. Vendors are starting to speak in terms of terabytesnot just gigabytes-of data. Data handling among the CPU, memory, and hard disk improves with 64-bit registers because the registers not only enable the system to move data around more quickly but can also reference a larger number of data chunks.

You don't need a 64-bit OS just to handle 64-bit-long integers, manage large files, or get yourself more memory. After all, you can use several 32-bit instructions to

come up with a 64-bit operation, split large files into more manageable ones, use a parallel design for multiple storehouses of memory, or opt for a large block of memory residing on a hard disk. However, 64-bit OSes are certainly the most straightforward technology for achieving these capabilities.

Beyond these general benefits, 64-bit OSes have distinct implications for desktop systems and servers. Desktop applications



will be able to exploit 64 bits to provide Nintendo-like graphics—first for 3-D-based programs and then for VR-based ones. Advanced GUIs are already available: Computer Associates' flagship management tool, CA Unicenter TNG, sports a new VR interface.

On the server side, the very-largememory (VLM) capability of 64-bit OSes will first attract developers in specialty areas, such as video on demand. The technology will then appeal to more mainstream OLTP and data-warehousing applications developers. Microsoft has pointed to credit-card transaction-authorization databases and worldwide reservation-system applications for its long-range move toward 64-bit NT.

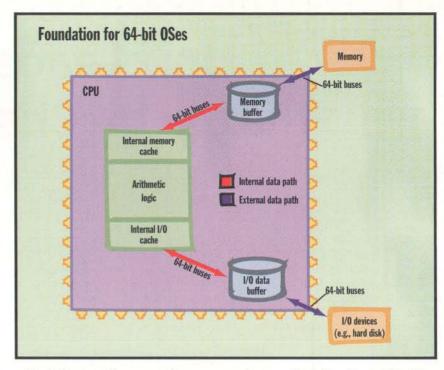
DBMS vendors and, increasingly, business-applications vendors say they will use 64-bit architectures to develop leading-edge technology and support their large corporate customers. Similarly, Unix vendors have jumped on the 64-bit bandwagon, partly because it's a way to keep Microsoft's NT development team on its toes (prompting Microsoft's vague public comments about 64-bit technology being in NT's future). Unix vendors might also find themselves in a battle to keep up technologically with the "Joneses": namely, 64-bit pioneers Digital Equipment and Silicon Graphics.

The Impact on Applications

Overall, 64-bit technology should have little impact on the fundamental architecture of applications, since programs are discrete and rather small data structures. However, applications will benefit from the following.

64-bit high-speed I/O: Commercial applications that shift data rather than just massage it can take advantage of the capability to boss around larger chunks of data more quickly. Devices that require improved I/O, including Nintendo's latest game station, QMS's printers, and Cisco's routers, also have the ability to exploit 64-bit technology.

64-bit logical/arithmetic operations: These operations increase the performance of "rocket science" applications based on complex data calculations, including satellite-imaging, weather-forecasting, technical-modeling, genetic-research, and simulation applications. Graphics also inherently benefit from high-speed calculations and extended



To deliver performance improvements over 32-bit systems, 64-bit OSes need CPUs with 64-bit data buses for memory and I/O.

memory capacity, as they are essentially continuous large data structures modeled discretely. In addition, 64-bit virtual addressing gives a boost to OLTP and datawarehousing applications, as well as more technical applications, such as computational fluid dynamics. All these types of applications require large amounts of memory.

Large files: This is a gain for all types of applications, as new features expand software and consume the ever-increasing hard disk space.

OS vendors are promising unified APIs and more advanced compiler technology for software developers who will need to write code for 64-bit OSes. Unix developers in particular will probably be the first to have a unified 64-bit Unix API that will enable 64-bit applications to run on any of the various versions of Unix that support 64-bit architectures.

You shouldn't expect an end to divergent APIs for 64-bit Unix, although we can certainly hope that the number of different APIs will be diminished. An interesting twist to the Unix tale is that the intricacies of 64-bit OSes are likely to lead to fewer versions of Unix as the smaller Unix vendors rally to the bigger ones, such as the Hewlett-Packard/Santa Cruz Operation team, which promises to deliver

a super 64-bit OS sometime during 1998.

How will OS vendors migrate from 32- to 64-bit applications support? Each designer team might take a different approach. For instance, Digital chose to skip 32-bit applications support, but it released a 32-bit translator for Ultrix and VMS to 64-bit Alphas. Sun pledges 100 percent binary compatibility between its 32-bit and 64-bit architectures.

Better Compilers

The same Solaris binary source will run on 32- and 64-bit systems, so it won't require the recompiling of 32-bit applications. However, this feature will come in handy only for a while, as recompilation is ultimately the only way to produce executables that use the full capabilities of 64-bit OSes. This process in turn requires sophisticated compilers that will be critical to the competitive edge of 64-bit OS vendors.

Even with a good 32-to-64-bit porting environment, there's still the question of which applications would benefit most from a conversion from 32 to 64 bits. The extra 64-bit coding is difficult to master and can actually decrease performance if the application doesn't have the ability to take advantage of the extra power delivered by the 64-bit OS.

	WHAT 64 BITS BUYS YOU		
Feature	Benefit vs. 32-bit OSes	Best Applications	
Larger files	Can process terabytes of data (vs. megabyte-size files).	OLTP; data warehousing; high-end graphics; processing- intensive applications; general business applications.	
Greater RAM	Memory can be a maximum of 18 billion GB (vs. 4 GB).	OLTP; data warehousing; high-end graphics.	
Faster processing	Can handle more calculations faster.	High-end graphics; processing-intensive applications.	
Faster I/O	Access times between main system and peripheral hardware are shortened dramatically.	High-end graphics; general business applications.	

Unix Pushes the 64-bit Envelope

Digital Equipment's Unix, IBM's OS/400, and Silicon Graphics' Irix are the only full 64-bit OS environments available today. Siemens' Reliant Unix (the merger of Siemens' Sinix and Pyramid's DCOSX) should ship by the end of the year.

Other OS vendors have opted for a piecemeal approach. For example, Sun's Solaris already supports 64-bit extended-precision arithmetic and large files, which can both benefit from CPU-specific instructions to speed up networking. You can expect Solaris to handle file sizes up to 1 TB in 1997 and to become a full-featured 64-bit OS in 1998, with a 64-bit kernel and 64-bit virtual addressing.

When will Microsoft deliver a 64-bit OS? Last June, the company promised that Cairo would support 64-bit very large memory (VLM) for applications needing more than the 4 GB of memory addressable with 32-bit systems. But the rollout of Cairo continues to be a fuzzy target (see "Unearthing Cairo" on page 145).

VLM will most likely show up in Digital's Unix for 64-bit Alpha systems, which already can potentially provide 14 GB of addressable storage. This memory space will soon increase to 28 GB—significant, but still a long way from an 18-billion-GB addressable with a true 64-bit OS.

This is why software developers have not started to 64-bit-enable their applications en masse, as few of these packages actually exceed the capacity delivered by 32-bit systems. Indeed, 64-bit technology is likely to come hand in hand with market education; this way, companies will be able to avoid repeating the mistake that Intel made when people realized that the Pentium Pro boosts 32-bit-application performance but delivers poor 16-bit-application speed.

64-bit Technology vs. Parallelism

As important as 64-bit technology is, it's only a small part of some larger changes that are currently taking place in OS devel-

opment. One trend is the fragmentation and modularization of OSes, which will confine the hardware-specific portion of the OS code to a small microkernel. Another trend is the adaptation of de facto standard OSes to parallel environments—specifically, symmetric multiprocessing (SMP), a shared-disk architecture; massively parallel processing (MPP), a shared-nothing architecture; and clustering.

The advent of 64-bit architectures is interwoven closely with the various approaches to parallelism. Both technologies benefit from the R&D and marketing muscle of vendors of relational database management systems (RDBMSes). These companies are employing 64-bit technology and parallelism to support next-gen-

eration RDBMS products, such as content management systems (CMSes), which handle structured and unstructured data alike. (According to one study, reported in the May issue of *European Software Markets Service*, CMSes will represent 28 percent of the total European database market by the year 2000.)

Cost vs. Speed

The best mix of 64-bit technology and parallelism, however, is unclear. "There's no easy answer," says Oracle marketing director John Spiers. "You have to balance cost and need, since infinitely fast is also infinitely expensive."

Indeed, the RAM needed to hold gigabyte-size databases does not come inexpensively. For instance, 4 GB of memory costs hundreds of thousands of dollars, compared to just a few thousand dollars for installing an extra processor in a parallel system. On the other hand, according to Jean Jacque Pairault, senior consultant of R&D strategy at Groupe Bull, you get a decreasing performance boost with each added processor. The alternative—a complete 64-bit system with a lot of memory—yields increased performance over 32-bit systems.

Vendors are unsure about how these technologies will improve your life. "Parallelism boosts performance in all situations, while 64-bit OSes help mostly in read-only situations, such as data warehousing," says Arthur Hochberg, European marketing director for Informix. On the other hand, "the large-memory approach is more relevant to OLTP than to data warehousing, where databases have grown too large for current hardware platforms," explains Spiers.

Alternatively, 64-bit technology may not be the most important issue. "At the high end, where people concentrate more on scalability than on large memory size, [the emphasis is on] solutions that combine parallel systems with advanced diskstorage technology," explains Jon Barnes, RS/6000 hardware product manager at IBM U.K.

The debate goes on. For the moment, the combination of 64-bit and parallel technologies will prove more beneficial to SMP than to MPP and clusters. Why? First, a 64-bit address space dramatically improves the scalability of SMP systems. Second, both technologies address different bottlenecks: SMP addresses a processing-power bottleneck, while 64-bit

WHERE THE ARROSPACE

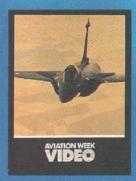
The Aviation Week Group: Print for every professional in global

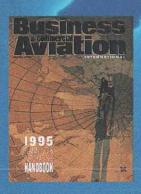




















WORLD TIRNS FIRST

and electronic products aviation and aerospace







AW Group Electronic Products

AWG on CompuServe Aviation/Aerospace
On Line

Aviation Week Video AW&ST Friday Radio Alert/WTOP-Wash., DC

WAD CD-ROM

LIFTOFF!

Aviation Week Group publications and electronic products comprise the most extensive family of leading information services in the global aviation and aerospace industry. Every publication is the leader in its market.

Whatever your professional affiliation with aerospace, you'll find magazines, newsletters, directories, conferences and electronic media ready-made to serve your specific information needs. Information when you want it, in the format of your choice.

If you are an advertiser, you'll find the Aviation Week Group has the media to match your markets. Civil, Military, Space — Technology, Business, Operations.

Aviation Week Group: 1 million+ readers 140+ countries

CONTACT US TODAY FOR MORE INFORMATION.

SUBSCRIPTIONS TEL: 1-800-257-9402 FAX: 609-426-7087 (OUTSIDE U.S. CALL 609-426-5526)

ADVERTISING TEL: 212-512-3084 FAX: 212-512-4225

AVIATION WEEK GROUP

memory reduces the processor-to-disk bottleneck.

Software developers are likely to postpone implementation of MPP, which requires a real architectural revolution, in favor of SMP, which is much closer to nonparallel systems. "For people who require very high throughput, the real battle will be between 64-bit technology and clusters, " says Julian Lomberg, Solaris product manager for Europe. The cost/performance ratio currently favors clusters, due to the huge cost of memory.

In the long run, we will see tighter integration of 64-bit and parallel systems, for two reasons. First, parallel-systems vendors are moving, albeit slowly, toward an architecture that combines SMP and MPP. Second, the data-warehousing and OLTP markets are converging as demand emerges for read/write analytical databases, where decisions from analytical work automatically feed into changes to production data.

Technology Mix

Very few of the 64-bit-enabled hardware platforms that are currently shipping actually sport the huge memory capabilities that make a real performance difference. Digital acknowledges that only about 30 percent of its 2000 64-bit Turbo Laser systems sold during their first 15 months of release have shipped with enough memory to actually benefit from the VLM capability of Digital Unix.

But standard Alpha configurations may soon ship with substantially more memory, according to Pauline Nist, vice president for Alpha Server operations. "DRAM prices collapsed by over 60 percent in mid-1996," she says. "Digital responded with a midrange server, capable of 8 GB of RAM, that started shipping in June." Bill Reed, advanced technology consultant for IBM's AS/400 business, predicts that by the end the century, AS/400s

Hardware Platforms with 64-bit Muscle

What hardware is available to support 64-bit OSes? All the leading RISC architectures currently use 64-bit designs. Intel's Pentium processors use 64-bit arithmetic operations and internal data paths. We expect that its successor, dubbed Merced, will be a full-blown 64-bit architecture.

Processor designers are further along in embracing 64-bit architectures than are OS developers. Today, there are 64-bit implementations for CPUs and for the data buses that interconnect the main processors with memory and I/O modules. Many data buses are 64 bits (or wider) to keep up with the CPUs that first implemented 64-bit arithmetic operations (i.e., load and store, and then add and multiply). The buses first arrived with a 64-bit internal data path and then moved on with a 64-bit external data path and 64-bit addressing. The latter enhancement enables CPUs to talk directly to 64-bit-wide memory.

All this lane-widening helps the CPU shuffle and process more data per cycle than in 32-bit systems. However, 64-bit architectures aren't the only way to boost CPU performance. Other performance enhancments include larger caches, higher clock speeds, more compact silicon wafers, and technologies such as very long instruction word (VLIW) for fewer but more complex instructions per cycle.

Six for 64

The following companies now offer 64-bit RISC processors.

Company	Processor platform	
Apple/IBM/Motorola	PowerPC	
Digital Equipment	Alpha	
Hewlett-Packard	PA-RISC	
IBM	AS/400	
Mips	Rx000	
Sun	SPARC	

will ship with at least 40 GB of memory and more than 50 TB of disk space.

Performance First

In the meantime, we need to closely watch how software suppliers take advantage of the underlying technology and see whether they implement 64-bit technology or parallelism, says Hochberg. But David Hughes-Solomon, director of technology at the client/server powerhouse SAP, believes end users don't care whether

their systems use a 32- or 64-bit OS. "End users are mostly concerned about how well an application performs, especially on a large scale. If it can deliver, then they look at the price and decide," he explains.

In the same way that most PCs consist of a mix of elements running at various speeds and bandwidth capacities (e.g., 128-bit memory buses, 64-bit graphics accelerators, and 32-bit processors), we will probably see a mix of 32- and 64-bit OSes, hardware, and applications. "Three to five years," reasons Hochberg, "seems a reasonable time frame for 64-bit technology to permeate the high end of the market, while 32-bit technology will keep on satisfying the bulk of the market for the foreseeable future."

WHERE TO FIND

Digital Equipment Corp. Maynard, MA (508) 493-5111 fax: (508) 493-8780 http://www.digital.com

Groupe Bull Louveciennes, France +331 3966 6060 fax: +331 3966 6062 http://www.bull.com Hewlett-Packard Palo Alto, CA (415) 857-1501 fax: (415) 857-5518 http://www.hp.com

IBM Old Orchard Road Armonk, NY (914) 765-1900 http://www.ibm.com The Santa Cruz Operation Santa Cruz, CA (408) 425-7222 fax: (408) 458-4227 http://www.sco.com

Silicon Graphics, Inc. Mountain View, CA (415) 960-1980 fax: (415) 390-6220 http://www.sqi.com Sun Microsystems, Inc. Mountain View, CA (415) 960-1300 fax: (415) 969-9131 http://www.sun.com

Laurent Lachal, a consultant specializing in IT, is editor of European Software Markets Service, a quarterly publication that analyzes OSes, applications development tools, business applications, and database management systems. You can contact him at editors@bix.com.

ILLUSTRATION: MERYSA NICHOLS © 1996

Unearthing Cairo

The next version of Windows NT will flex its enterprise muscle by incorporating features from "Cairo."

By Mark Minasi

t the first NT developers conference in 1992, Bill Gates announced that Cairo would arrive in three years and would incorporate object-oriented technologies, especially an object file system. Since then, we've seen Windows NT 3.1, NT 3.5, NT 3.51, and most recently NT 4.0. None is object oriented, none has an object file system, none is Cairo. It seems that Cairo is Microsoft's sly way of promising

the world. "Will we see Plug and Play in NT?" "Oh yes, of course, in Cairo." "Will NT ever produce world peace and cheap antigravity?" "You bet-in Cairo."

What is becoming apparent is that we'll never see Cairo as the manifestation of Microsoft's next-generation operating system. But much of the development work that went into the Cairo project will see the light of day. Indeed, some Cairo features have already been bolted onto NT 4.0, and others may be slipstreamed into interim NT releases or will appear in the next major release of NT sometime in 1997 or early '98. Either way, don't expect to see a shrinkwrapped box of Cairo at your corner software store.

For its part, Microsoft is framing its course correction in the best possible light: Cairo isn't an OS, it's a set of technologies. What does this mean for current NT users or for those people who are

contemplating a switch? Here's a rundown of the Cairo features you can expect to see in future versions of Windows NT.

Networking Enhancements

Windows NT will continue to be Microsoft's "enterprise" OS as the company tries to push into large corporations and pry data off mainframes and Unix machines and onto PCs. To that end, the company has partnered with companies such as Digital

Equipment to gain access to big-iron IS managers. But NT is developing a reputation more as an excellent OS for workgroup servers than for enterprise-level systems. Thus, one of Microsoft's missions is to instill NT with more enterprise character. To do that, Microsoft must refine how NT handles domains. NT's domain structure looked wonderful when compared to Net-Ware 3.x's server-based bindery, Novell's term for a server's list

of recognized users. Unfortunately, domains pale as an enterprise structure beside NetWare 4.x's NetWare Directory Service (NDS).

That's because NT currently lets you centralize the lists of user accounts for

a number of servers on one single server-kind of a security server-called a primary domain controller. Taken together, these servers constitute a domain, in Microsoft parlance. (NT allows you to establish "backup" domain controllers as well.) If you've got 50 servers in that domain, then you have to build your company's users only on one server rather than having to rebuild them 50 times, once on each server. But NT-based enterprise networks become clumsy when a second domain appears, which requires administrators to manage interdomain security treaties called trust relationships. The number of these relationships can easi-

ly grow to become almost unmanageable. For example, six domains require 30 trust relationships, but in organizations with 50 domains, the number of relationships soars to 2450.

One of Microsoft's main development efforts will be to reply to NDS. Instead of having to create dozens of domains, and then having to establish hundreds of trust relationships among them, you'll probably be able to create "trees" of domains. While Microsoft hasn't released much information about this change,



we expect to see a domain tree notion that sounds suspiciously like Novell's directory trees in NDS. In fact, Microsoft has recently taken to calling its current domains-and-trusts model Microsoft Directory Services, or MDS.

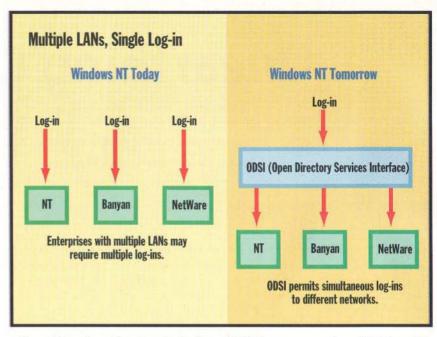
Additionally, NT's current notion of one primary domain controller and a collection of subordinate domain controllers may give way to multiple master domain controllers, a great boon to maintaining geographically widespread domains. Currently, it's possible (and convenient) to put a backup domain controller in a branch office. That backup domain controller can authenticate network log-ins, so users in the branch office needn't wait for their log-ins to occur over the slower WAN links to the primary domain controller. In fact, the WAN link can be down altogether and users can still log on through the backup domain controller.

What users can't do now is change anything about their accounts: passwords, groups they're members of, etc. They can do that only if they're connected to the primary domain controller. The multiple master domain controller model would mean the domain controller in the branch office could handle changes locally, reconciling them with the other domain controllers when the WAN link comes back up.

The Cairo Internet

Two pillars of Microsoft's Internet strategy, the Dynamic Host Configuration Protocol (DHCP) and the Windows Internet Naming Service (WINS), will also see changes in future versions of NT. DHCP is a system that greatly simplifies installing IP addresses and TCP/IP configuration information on a new PC, DHCP allows you to create a server that hands out that configuration information. The problem is there's no simple way to provide fault tolerance for the server's function-it's not acceptable to have two DHCP servers on a network handing out IP addresses from the same pool of addresses. The Cairo development effort is working to change that: DHCP servers will be able to replicate among themselves so that if one goes down, the others know what that server was doing.

WINS, Microsoft's server-based "naming" system, supports NetBIOS-based programs (like Microsoft's own network redirector). And it provides translations between human-friendly names like



Open Directory Services Interface (ODSI) can support unified log-in and administration tools for a variety of network operating systems.

"Bigserver" and the necessary IP addresses like 210.32.11.87. The problem with WINS is there already is an Internet standard called the Domain Naming System (DNS) that handles this chore. NT-based Internet servers must run both WINS and DNS, and they must somehow persuade the WINS server to share its knowledge with the DNS server. The Cairo approach does away with WINS altogether by wedding DNS and WINS into something called Dynamic DNS, which reportedly is working its way through the request-for-comment process now.

What's more, Services for NetWare (the new name for the combined File and Print Services for NetWare and the Directory Services Manager for NetWare) will include NDS support, something even the NT 4.0 version of Services for NetWare lacks. The Microsoft networking client will include client-side support for the Lightweight Directory Access Protocol (LDAP) as well. Microsoft's big push for creating unified log-in and administration tools sits atop its support of Open Directory Services Interface (ODSI). A user control tool like the User Manager would sit atop an ODSI layer; there would be ODSI drivers for NT, Banyan, NetWare, or other networks. This ODSI-dependent User Manager would handle user accounts for each of those network operating systems. Similarly, an ODSI-based log-on could

perform simultaneous log-ins to different networks (see the figure "Multiple LANs, Single Log-in").

Desktop Enhancements

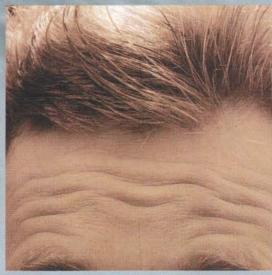
While the enterprise is important, Microsoft also has to battle for corporate desktops. First and foremost is Plug and Play support. This is essential if NT's going to be a simple-to-use OS, given today's PCs and the market's embracing of the PCI bus. PCI's great for its speed and flexibility, but it is nightmarish to try to set IRQs, DMAs, and memory addresses on PCI-based machines, which typically don't give you a way to control what resources your PCI add-in cards claim. Plug and Play gets rid of these problems.

So, why wasn't Plug and Play in Windows NT 4.0? According to NT product manager Andrew McGehee, Microsoft just didn't have time. While Plug and Play may be simpler on Intel platforms, putting it into Mips, PowerPC, or Alpha systems is tough and will require some development support from hardware vendors.

Microsoft is also working to make drivers for hardware easier to come by. The company will merge the driver models of Windows 95 and Windows NT. Because drivers for 95 and NT are now different, board vendors without large programming staffs often end up ignoring NT driver development or staying in "perpetual



Ministry of Economics, Technologie and Transport Nordrhein-Westfalen Germany



GERMAN INNOVATION

Creative concepts begin in your head. Our raw material is our know-how, our capability to connect things. And that's how precision solutions and products for the challenges of tomorrow come about. We in NRW, where innovation is tradition.

Comdex, Las Vegas, Sands Expo & Convention Center 18. - 22. November 1996 Upper Level, Stand S3666/S3966

Toll free fax back: 1-800-700-8247 ext. 400



made Germany



the: 11 www. byte. com/ver. him.

Rack Mount or **Tower SPARC 5/** 20 from Rave.

Now, An Exclusive SPARC™ System Not Available From Sun!

ENGINE BY SUN, **BODY BY RAVE**





- · 36GB internal hard disk capacity
- · supports up to 8 internal devices
- · SPARCstation 5 or SPARC-station 20 motherboard
- · single, dual or quad processors
- · Solaris® 1.x or 2.x operating system compatibility
- · RAID-capable

Circle 220 on Inquiry Card.

The POWER Tower or Rack incorporates the flexibility of Sun's M-Bus or microSPARC™ II technology into a Rave POWER Rack or POWER Tower solution.

The POWER Tower or Rack provide easy front access for eight internal devices to simplify resource management for Firewall, Telco, Internet, Network Management and other servers. Sun original system boards in Rave exclusive chassis' optimize power and convenience for the real world enterprise.

Rave Computer Association, Inc.



36960 Metro Court . Sterling Heights, MI 48312 Fax: (810) 939-7431 • E-Mail: info@rave.com

http://www.rave.net

Cairo Inside

An object-oriented, next-generation operating system called Cairo may never ship. However, future versions of Windows NT will enjoy the fruits of the Cairo development effort.

Cairo Technologies

What They Do

Microsoft Directory Services

Refine how NT handles domains; may use a tree structure à la Novell's NDS for creating one primary domain controller with a collection of subordinate domain controllers.

Dynamic Host Configuration Protocol (DHCP) servers will replicate among each other.

If one DHCP server goes down, another server will be able to

Replace Windows Internet Naming Service (WINS)

Successor will wed WINS with Domain Naming System (DNS), the existing Internet standard for translating human-friendly server names and the necessary IP addresses.

Client-side support for the Lightweight Directory Access Protocol (LDAP)

Provides a low-overhead way for clients to access X.500 directory services.

Support for Open Directory Services Interface (ODSI)

Creates unified log-in and administration tools for enterprises with a variety of network operating systems.

Plug and Play support

Simplifies installation of peripherals that use the PCI bus.

Merge Windows 95/97 and Windows NT driver models

A boon for NT users who often have to struggle to find appropriate drivers for their OS platform.

Bookmark API

Restores the screen and PC state to where they were when you shut down the system.

Object File System

Lets you create a pseudodirectory that unifies local, network, and

Internet files.

Power management

Resource efficiency for laptop users

beta" stage. Microsoft will also try to simultaneously ship Windows 97 and a new version of NT next year. The two OSes will still be quite different, but they'll use identical drivers for sound cards, video boards, network cards, and the like. Hardware vendors will all want to support Win 97, so there'll be tons of drivers for Cairo: a bonanza for NT users.

UI Updates

The NT user interface, which went to the Windows 95 style in version 4.0, will continue to evolve. Expect to see the "Nashville" version of the Explorer, which integrates a Web browser and a disk browser. This may appear before the next major edition of NT, perhaps as part of a service pack.

An interesting rumor, and potentially the most important UI improvement, is the Bookmark API, a set of programming extensions for the UI. Here's how it would work: You shut down NT

You Don't Have To Use Brute Force To Make Sure Users Pay For Their Software.

FLEXIm® The Elegant Solution

You don't have to use the brute force of a baseball bat – or dongles for that matter – to make sure only licensed, paying users have access to your software. There's a much more elegant and cost-effective solution: FLEXIm from GLOBEtrotter.

The De Facto Standard

FLEXIm is bundled in over \$15 billion of installed UNIX" and Windows" software products, making it the de facto standard in license management. And in 1995 alone, FLEXIm was used to ship over \$3 billion in software licenses over the Internet. That makes it the de facto standard in electronic commerce for software, too.

Even Works With Dongles

If you still want to use dongles, FLEXIm significantly reduces the number you need at a customer site by allowing low-cost dongles to be used as "network dongles," and by sharing dongles across different products.

Your Customers Will Like It

In an independent survey, users preferred FLEX*lm* eighteen-to-one over other license managers. And all of us know customers really don't care for dongles. With FLEX*lm*, your customers benefit from:

- Floating licenses allowing licenses to be shared over a network, while fairly compensating the vendor with a higher price per license.
- Fully functional evaluation software while the vendor knows the software will stop after a specific date.
- Built-in license compliance –
 customers don't need to buy expensive
 license metering utilities to verify they
 comply with vendor license terms.
- Installing software where it is most appropriate from a hardware or administration perspective, while protecting your software.

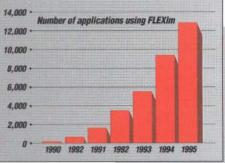
Windows, UNIX and Java

If your company develops products on multiple platforms, you should know FLEXIm runs on Windows, UNIX and Java.

For More Information

Call us at 408-370-2800, email us at info@globetrotter.com or visit our website at http://www.globetrotter.com. We'll be happy to arrange a demo and show you how to make sure all your users are licensed.

Circle 221 on Inquiry Card.



Key Features:

With FLEXIm you can:

- Limit software use to licensed users
- License software in new ways

to gain new markets and customers

- Leverage the Internet and CD-ROMs to increase sales while reducing selling and manufacturing expenses
- Reduce the cost of product evaluation programs
- Significantly reduce the use of expensive dongles

Ask about our white paper on Electronic Commerce For Software

GLOBEtrotter

Electronic Commerce For Software™

http://www.globetrotter.com Email: info@globetrotter.com Telephone: 408-370-2800 Fax: 408-370-2884

FLEXIm is a registered trademark and "Electronic Commerce For Software" is a trademark of GLOBEtrotter Software. All other trademarks are the property of their respective owners.

while Word and Exchange are running. The system says to Word, "Tell me what you're doing." Word replies, "I'm on document X at page Y with the cursor on the 300th character." Exchange reports similar info. When you start up your system the next day, Word and Exchange launch, and document X loads. The screen and state of the PC go back to where you were when you shut down the day before.

Information may become easier to find thanks to the Object File System (OFS). For example, if you're interested in pictures of the Space Shuttle, you may already have some files on your C: drive and others on a D: drive. An FTP site may post new pictures, and Web sites may also store shuttle images. The OFS would allow you to create a pseudodirectory that would seem to contain the scattered data from all these locations.

WHERE TO FIND

Microsoft Redmond, WA (206) 882-8080 http://www.microsoft.com Servers will benefit because network objects, such as shared directories, won't be associated with a particular machine. You'll just see a shared object called "mail database" and attach to it, without having to know what server it's on.

Other new features will include NT support for Direct3D and DirectInput, FireWire/P1394, and the Universal Serial Bus. And for laptop users, there's power management coming, Microsoft says.

Beyond Cairo

What must Microsoft address after Cairo pushes the evolution of NT? It will have to match the 64-bit muscle of chips like Digital's Alpha. Microsoft says there will be a 64-bit NT "in the next couple years." Fault tolerance *must* appear in all networking services, and NT's clustering "Wolfpack" technology will need to move beyond simple support of pairs of machines. Let's hope Microsoft's fascination with the Net extends to better support for TCP/IP infrastructure issues like better dynamic routing protocols, better support of static routing over

Beyond Cairo

Here's a wish list of improvements that need to be part of Microsoft's long-term development plans.

Support for 64-bit processors

Fault tolerance for all networking services

Clustering support for more than pairs of machines

Better dynamic routing protocols

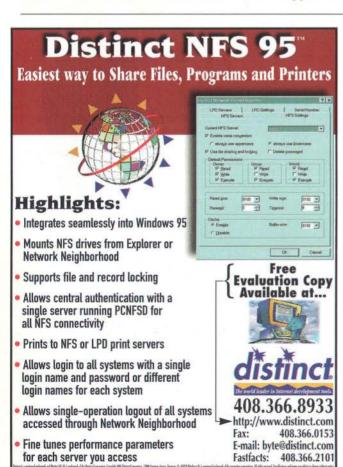
Improved static routing over remote access servers

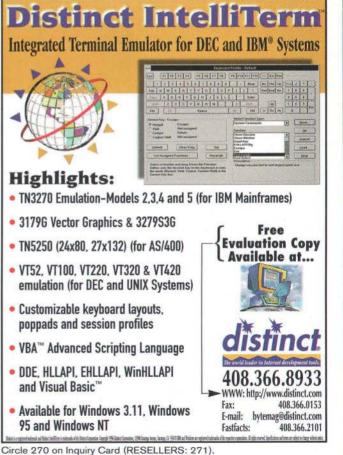
IPng support

remote access servers, and IPng.

But beware of basing your enterprise plans on Microsoft plans. Cheap antigravity may come before Plug and Play and other enhancements NT needs.

Mark Minasi writes books and gives seminars on desktop and network OSes. You can reach him at mark@mmco.com.





JSTRATION: MERYSA NICHOLS @ 1996

Copland, Revisited

A closer look at how the microkernel and hardware abstraction services will strengthen Apple's upcoming OS.

By Tom Thompson

or more than a year, Apple has provided tantalizing glimpses of Mac OS 8, its future OS, which is more commonly known by its code name of Copland. Unfortunately, much like Microsoft's Windows 95 launch, the release of Copland has been plagued with delays. The expected shipping date has slipped from this year until well into 1997. (For BYTE's previous coverage of Copland, see

"Apple's New Operating System," June 1995, and "Copland: The Abstract Mac OS," July 1995.)

At the August MacWorld trade show in Boston, Apple CEO Gilbert Amelio announced a new blueprint for OS releases. Instead of a monolithic release of system software, as happened with System 7, Apple will release portions of Copland piecemeal over the next year.

Component of the Month

This piecemeal plan has several benefits. First, the development breaks into manageable chunks for the system-software engineers. Any bugs that appear after a release are probably due to the newly introduced OS components, which simplifies code maintenance.

Second, some of the promised Copland technologies will get into the hands of users without their having to wait for Apple to

roll out other portions. For example, an OS release slated for the middle of 1997 will provide many Copland user-interface (UI) elements, Java support, and a much-needed multithreaded Finder update, as shown in the figure "Copland Architecture" on page 152. (The improved object-based UI, with sophisticated messaging and scripting functions, was the easiest part of the Mac OS to win early release.)

Finally, the staggered-release schedule means that Apple

can craft some of these components as 680x0 code. Thus, some of Copland's features—but not all—will be available to owners of 680x0-based Macs.

This incremental-release strategy has problems, too. Copland's elements can't all separate conveniently into discrete components. The most glaring examples: System 7.x's File Manager and parts of the I/O subsystem (still emulated 680x0 code). Releas-

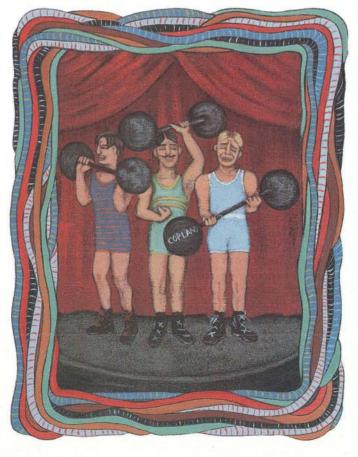
ing these crucial parts as native code early would boost the performance of PowerPC-based Macs and Mac clones, but, says Apple-Soft vice president Jim Gable, "Much of the file-system code is tightly coupled to the preemptive features of the Copland microkernel: There's no way to separate them."

This plan also affects new PowerPC Platform systems next year: Such systems will need a special System 7.x to manage the hardware abstraction for each hardware design. Finally, Apple must work closely with third-party developers to spot and fix problems that these small releases might cause to applications software.

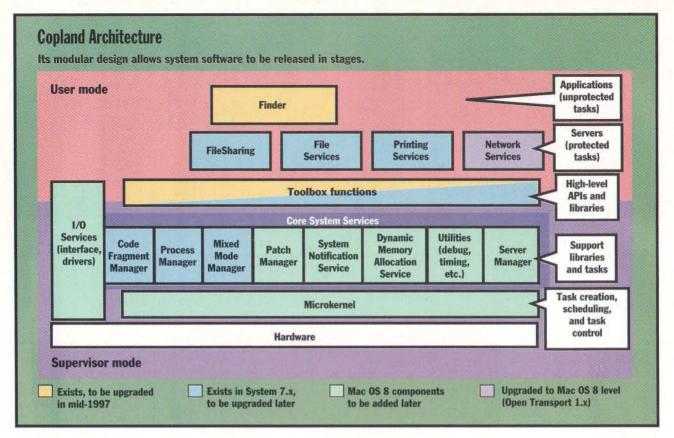
In Apple's favor, it has experience in extending the OS in stages. Separate releases of QuickDraw GX, QuickTime, QuickDraw 3D, and Open Transport added new capabilities to System 7.5 without revamping the

OS code. Furthermore, Apple has been designing parts of the system software as OpenDoc components. This helps the plan because OpenDoc is a modular architecture, the very thing required to ship the OS as parts.

With all these sudden changes in direction, trying to figure out exactly what Copland is requires a scorecard. I'll review the Copland system architecture first, then focus on the latest information available on the microkernel and I/O abstraction.



continued



As of now, Copland consists of several parts: microkernel, core system services, and tasks. The microkernel performs all low-level services directly with the processor or hardware: task creation (programming the processor's memory management units [MMUs] to set up a separate memory space and access rights), scheduling (with the processor's interrupt mechanism and timers), and task control (which uses processor-specific atomic instructions for low-level messaging and semaphores).

Modular Microkernel

The microkernel has a modular structure that lets other software modules (e.g., ones that implement a virtual memory backing store or perform memory allocation) plug into it without modification. This differs from some Unix kernels, where adding a new service requires you to rebuild the kernel. The microkernel's design also supports symmetric multiprocessing (SMP) on systems that have multiple processors. A low-level multiprocessor API has been available for special-purpose applications under System 7.x, and it will work under Copland.

The core system services are clients of the microkernel. They implement a

number of services that higher-level portions of the Mac OS rely on. These services consist of either DLLs or OpenDoc components. Some of them are familiar services, such as Code Fragment Manager (which loads and unloads PowerPC code libraries), Process Manager (which manages task creation), and Mixed Mode Manager (which handles transitions between native PowerPC code and the 680x0 emulator).

However, there are also many new services, such as Patch Manager (tracks software patches), System Notification Service (coordinates tasks), and Dynamic Memory Allocation Service (no more fixed memory partitions). Some core software utilities have obvious functions, such as Debug Services, Interrupt Services, Timing Services, and Exception Handler. Another utility, Server Manager, creates and controls special-purpose processes, as described below.

The last part of the OS architecture consists of tasks. A task is a basic unit of program execution in Copland. Processes consist of one or more tasks and use a common set of memory and system resources. Notable examples of processes are the Finder (the shell application that manages the Desktop screen and han-

dles certain file operations), Printing Services, and FileSharing (which implements peer-to-peer network services).

A process's code might be located in RAM or on disk, and it has its own stack and register set. Even better, because of Dynamic Memory Allocation Service, such code need not occupy a contiguous section of memory. Instead, a process's code fragments can be located anywhere in memory, arranged as necessary to best fit a limited amount of RAM.

The familiar Mac application consists of a main task the Process Manager sets up, plus any threads this main task spawns via the Thread Manager. Mac applications can create one or more threads, which implement single paths of execution. For new Copland-aware applications, the microkernel can schedule the tasks to execute simultaneously, which improves load balancing on the system.

It's important to note that certain parts of Copland's services (e.g., the Quick-Draw graphics engine) contain nonreentrant code. Therefore, any task using these services must be scheduled to execute cooperatively (i.e., one at a time). Typically, these are applications because they make heavy use of the UI.

Because the Process Manager creates

ADOBE FRAMEMAKER 5 on WINDOWS 95 & NT. MAKES SHORT WORK OF LONG DOCUMENTS.





Adobe* FrameMaker* 5, the leading document publishing software, automates your time consuming authoring, formatting, and page layout tasks. And now its multi-platform* support includes Windows* 95

and NT. Adobe FrameMaker lets you easily create long documents like books with cross-references and indices. What's more, it's the perfect tool to distribute

Download a free HTML plug-in from www.adobe.com/special/hotamale

proposals, engineering specs, training manuals and more. If you've got a big job on any platform, now you've got the power to meet the challenge. For more on Adobe FrameMaker 5, call 1-800-388-9883 extension 23708.

If you can dream it, you can do it.

^{*}Also available on Windows 3.1, Macintosh, Power Macintosh, and UNIX: SunOS, Sun" Solaris, HP/UX, Digital UNIX; Silicon Graphics IRIX; IBM* AIX: Adobe, the Adobe logo, FrameMaker and the tagline, "If you can dream it, you can do it" are trademarks of Adobe Systems Incorporated. All other marks are the property of their respective companies. ©1996 Adobe Systems Incorporated. All rights reserved.

and launches each application's main task, it ensures that only one main task executes at a time. The microkernel, certain core system services, and any task that doesn't rely on graphics can operate under preemptive time scheduling. Processes that provide specific functions but don't need a UI—such as those that handle file-system and network services—are called servers.

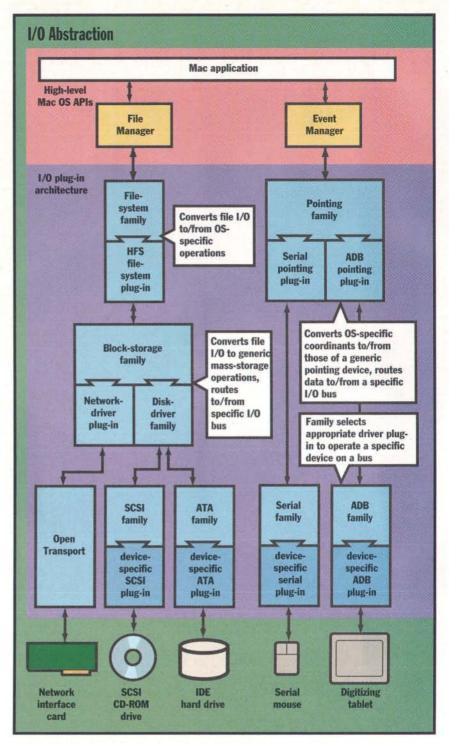
Copland's architecture thus makes Apple's release plan possible. The scheduled mid-1997 release, for instance, consists of a new process (the Finder), which System 7.5 treats as an application. This release will also provide an assortment of DLLs that implement the Copland UI elements and the Java virtual machine, which, again, System 7.x's Code Fragment Manager can handle.

Memory Matters

Copland's microkernel provides memory protection and address-space isolation, except for existing System 7.5 applications. The microkernel, drivers, and certain servers execute in the PowerPC processor's privileged mode. Most servers and Mac applications operate in the processor's user mode, and they can obtain memory or perform I/O only by making requests to the OS. This improves the overall system reliability because it ensures that only the low-level OS code can directly operate the hardware, such as fielding interrupts, modifying the access attributes to sections of memory, and controlling the processor's caches.

The microkernel provides another level of protection by placing servers and OS code in separate address spaces. Accessing a separate space requires building its address using values from pagetable entries (PTEs) in the processor's MMU. Because only the microkernel can use and modify the PTEs, this effectively "walls off" these tasks from any errant memory accesses that a malfunctioning program generates. Copland maps the microkernel code into every address space, so that tasks can quickly use system functions without involving cycle-stealing memory-access mechanisms. This scheme still provides ample protection, because the OS code is marked read-only.

For compatibility's sake, existing Mac applications and certain sections of the UI Toolbox code must cohabit a single memory space: The System 7.x application model expects a contiguous address space



Copland achieves hardware independence through a layer of interface libraries and plug-in modules.

and unfettered access to some system globals. Still, Code Fragment Manager flags system code and native System 7.x applications as read-only, which offers some protection.

Process Manager also provides an extra level of safety. When it loads a System 7.x application, it places *guard pages* above and below the application's fixed memory partition. These guard pages are marked with excluded access permission. If an application attempts to overrun its boundaries, it generates an exception. It's possible that a misbehaving application

We put the inexpensive ?

back in

(Redundant Array of Inexpensive Disks according to original Berkeley acronym)



Patent #371,768



LynxStak™ - Maximum performance at a minimum price.

Inexpensive Cost Per Megabyte.

If you need the protection RAID has to offer, but the expense has been holding you back, then Artecon's new desktop LynxStak is your solution. For about the same price as many standard 3.5" drive subsystems, LynxStak gives you all the benefits of RAID. By purchasing the RAID system to fit your needs, you can expand incrementally without the limitations or cost of a pre-configured box. And LynxStak is the only desktop RAID solution that offers the high availability and redundancy once available at the more expensive enterprise level.

Removable, Redundant and Reliable.

LynxStak gives you the utmost in reliability with features like true hot plug removable disk drives. Independent front-removable power supplies and rear removable cooling fans provide both high availability and easy serviceability. Optional hot plug removable LynxRAID controllers can be configured for dual failover providing you with the extra redundancy needed for mission critical applications. LynxStak supports RAID levels 0, 1, 0+1, 3 or 5 for complete flexibility and optimal performance in your environment.

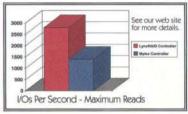
1-800-USA-ARTE

http://www.artecon.com

E-mail: stakad@artecon.com

Superior Price-Performance.

Don't let the low price of the LynxStak fool you. Exceptional performance and excellent transfer rates are packed into our compact 3.5" form factor, LynxStak outruns the other RAID systems on the market with a 486-DX2 processor resulting in extremely



fast transfer rates at all RAID levels. Fast-wide end-to-end interfaces, multiple drive channels and custom ASICs contribute to maximum performance at a minimum price.

Investment Protection.

With LynxStak, you can incrementally upgrade into the RAID system of your choice as your needs grow. From a single desktop unit to a powerful server configuration, you never sacrifice your original Lynx investment. Desktop RAID systems start at 4GB and can be expanded easily and incrementally to over 100GB. And, LynxStak is compatible with virtually any platform including Sun, HP, SGI, Macintosh and PCs running Windows NT/Windows 95.

So call Artecon today and see how we stack up!

Visit us at COMDEX Fall '96 Booth #S7011

Enterprising solutions for your enterprise.™

PO Box 9000, Carlsbad, CA 92018-9000 (619)931-5500 FAX (619) 931-5527 email: sales@artecon.com A Member of the Nordic Group of Companies

might corrupt the data of another application, because everyone can modify any of the data inside this address space. However, given the address-space isolation and write-protection safeguards, Copland is significantly more reliable than its predecessor, which has no protection mechanisms.

The payback for this compromise is that users can carry their existing body of Mac software to Copland and expect it to work. AppleSoft's Gable admits: "If we could rewrite the OS without regard for the installed software base, the job would be done by now."

I/O Abstraction

One goal of Copland is greater independence from the hardware. Given the growing Mac-clone market, vendors need to differentiate their systems by distinctive hardware features. Also, the Mac OS needn't rely on erratic supplies of custom ASICs that have, on prior occasions, crimped sales.

All I/O operations—from hard drive to video to pointing devices—are grouped into families (see the figure "I/O Abstraction" on page 154). An I/O family is a set of software components to perform specific I/O services. If a task uses the SCSI family, that in turn uses interface modules (called plug-ins) to operate SCSI devices.

For example, one application might—via the OS—call the SCSI family to perform file I/O to a device on the SCSI bus. The SCSI-family module calls the plug-in that manages a SCSI hard drive. Next, a scanning application uses the SCSI family, but this time the SCSI-family module calls a plug-in to control a color scanner.

The I/O family provides an interface library that implements device functions and exports data structures for use by the applications or the OS. Although an I/O-family module provides one interface, it might have two sets of interface libraries: one for user-mode tasks and another for supervisor-mode tasks. The OS uses the supervisor-mode library, which can be performance-tuned because it doesn't require the user-mode I/O request mechanism, and no address-space conversions are involved.

The I/O-family architecture provides a remarkable degree of hardware abstraction, because an I/O family can call other families to route data to the appropriate device. Suppose an application calls File Manager to perform file I/O. File Man-

Copland Highlights

Apple will release the OS in stages. Open Transport for networking is already out. A mid-1997 release will provide:

- Native PowerPC multithreaded Finder.
- · Java virtual machine.
- Advanced user-interface elements.
- · OS parts for 680x0-based Macs.
- The Patch Manager's limited support for 680x0-trap patching.
- Complete memory protection for the kernel, drivers, and server tasks. The kernel provides preemptive scheduling with priority levels.
- Limited memory protection and cooperative task scheduling for existing applications that require user interface (necessary for compatibility).
- Support for multiple processors,
 QuickTime 2.5, QuickDraw 3D, etc.,
 already multiprocessor-ready.

ager first calls a file-system family. This family calls a file-system plug-in, which implements a particular OS file format, such as the Mac's HFS or Windows NT's NT File System (NTFS).

The file-system plug-in next calls the block-storage family, which orchestrates operations on large-capacity, random-access storage devices, such as hard drives, CD-ROMs, or digital videodiscs (DVDs). This family in turn calls a disk-driver plug-in or a network plug-in if the target device is on a network. If the disk-driver plug-in is called, it might call the SCSI family or the ATA family, depending on whether the target device is a SCSI or an IDE drive.

Adding a new device usually requires writing a driver that conforms to the Open Firmware specification (IEEE-1275-1994) and a suitable plug-in. Practically, the Mac OS probably won't use an NTFS plug-in, because you normally access such storage indirectly through a networked NT server. However, that you *could* write such a plug-in shows that the microkernel is completely uncoupled from its file system. So, if Apple uses a better file-system format later, it can add a plug-in without revamping the system software.

Furthermore, access to new device interfaces and peripherals is vastly simplified. Normally, you'd have to wait for a new OS release to gain use of a new device interface (e.g., IEEE-1394 Firewire). With Copland, you simply add a Firewire board and the corresponding plug-in modules that handle the Firewire interface. You then connect a peripheral.

The Once and Future OS

The major problem with Copland: When will it finally ship? While the incremental-release strategy is difficult, Apple has shown it can add new capabilities to System 7.x without overhauling the OS code. Open Transport's release is a prime example. This Copland networking technology was in users' hands last year, letting Apple fix bugs and tune performance before Copland itself ships. Still, releasing the microkernel as soon as is practical helps Apple, because it will significantly enhance the Mac platform.

First, Copland will boost the performance of PowerPC systems by eliminating almost all the emulated 680x0 code. The staged-release schedule also offers the possibility that some Copland services will appear on 680x0-based Macs. The new memory services will also make efficient use of available system RAM.

Another major benefit is that Copland will exploit the computing power of multiprocessor systems. The OS will distribute tasks, which server applications created by calling the microkernel services, among the processors for better load balancing. (For compatibility, applications that spawn threads via Thread Manager must be cooperatively scheduled.)

Technologies such as QuickDraw 3D and QuickTime 2.5 already use reentrant code and can automatically leverage the power of a multiprocessor system under Copland. The multiprocessor systems from Apple and DayStar Digital provide the hardware necessary for work in this area.

Finally, Copland's hardware abstraction will let clone vendors offer a variety of systems. One vendor might opt for low-cost parts, while another might provide advanced high-performance peripherals for vertical markets or custom jobs. This variety lets you pick the system that best fits your needs, and the competition will hold the line on system prices.

Tom Thompson is a BYTE senior technical editor at large with a B.S.E.E. degree from the University of Memphis. You can contact him on the Internet or BIX at tom_thompson @bix.com.

First Desktop RAID for SPARC™

RD 10

RAID Storage Subsystem

Features

- High Availability
- True RAID data integrity
- Fast throughput-17mb/sec
- Up to 25.2GB storage
- SPARC/SUN pizza box form factor
- . Easy to use GUI

When you need your data safe, reliable, and ready, the Integrix RD10 delivers high performance with low cost per Mbyte.

Thanks to a dedicated 33MHz RISC processor and enhanced RAID technology, combined with dedicated I/O processors for each drive and host, the RD10 reaches throughput speeds in excess of 17Mbytes/sec. For high availability environments, dual fast/wide SCSI ports make your data available to two hosts simultaneously.

Five different hardware RAID levels, hot spare disks, and hot-swappable drives keep your data safe and secure. Data automatically and transparently rebuilds on the spare drive eliminating downtime and data loss. Data integrity is assured for all mission-critical applications.

The RD10 Graphical User Interface eliminates the need to type obscure commands found buried in the back of a service manual. Historical performance software analyzes and fine tunes your RAID. Configuration and firmware upgrades can be handled automatically. RD10 status and context-sensitive online help are made instantly available. All with the click of a mouse button.

RD10 RAID Storage Subsystem

Compatible with Solaris and Windows NT

RD10 RAID Throughput Performance

5400rpm F/W SCSI-2 HDD)	Mbytes/sec	IOs/sec	
Sequential Read (max)	16.8	1307	
Sequential Write (max)	17.2	1247	
Random Read (max)	9.9	620	
Random Write (max)	13.0	357	

RD10 RAID Subsystem Specifications

RAID Levels Supported Processor Cache Memory Channels

Disks Supported

0, 1, 3, 5, 6, (0+1)
33MHz 32bit RISC
8Mbytes to 128Mbytes
2 host channels
6 disk channels
3.5", 1" high
SCA-2 or 68-pin connector

SCA-2 or 68-pin connector
Fast/wide Single Ended SCSI-2 interface



Corporate Headquarters

2001 Corporate Center Drive Newbury Park, California 91320 Tel: 800-300-8288 / 805-376-1000 Fax: 805-376-1001

Email: sales@integrix.com http://www.integrix.com

Asia

Beijing, P.R.China Tel: 8610-253-5305 Fax: 8610-253-5306 Seoul, Korea Tel: 822-515-5303 Fax: 822-515-5302

www.integrix.com

© 1996 Integrix. Inc., Integrix and the Integrix logo are registered trademarks and UWS, IGS, SEC, RD, HA, SGX, TGX, SWS and SSC are trademarks of Integrix, Inc. All other trademarks mentioned are the property of their respective companies. Manufactured in USA. Internationally supported.
Circle 216 on Inquiry Card.

Diagnose any PC's problems fast with

UNIVERSAL DIAGNOSTICS TOOLKIT

- Get the best, most accurate full-system diagnostics package for all your problem PCs.
- Low-Level Formats all hard drives including IDEs. Allows relocation of Track O.
- Works with any PC regardless of O/S: DOS, Windows 95 & NT, O/S2, Unix, Novell, etc.

Loop-back Plugs— 9-pin serial, 25-pin serial and 25-pin parallel plugs, used for external I/O port testing.

2 Micro-Scope floppy disks containing the best PC diagnostic tools on the market. Comes with both 3.5" and 5.25" disks to work with any PC.

Micro-Scope 6.1

Fully O/S independent diagnostic software...

Call for upgrade pricing & complete new features list!

MICRO-SCOPE Universal Computer Diagnostics was developed to satisfy the expanding need for accurate system diagnosis in the rapidly growing desktop computer market. Patterned after super-mini and mainframe diagnostic routines, MICRO-SCOPE runs independently of any standard operating system, and is therefore at home on any machine in the Intel world. Speed, ease-of-use, and razor sharp ACCURACY are a few of the advantages that arise from this system independence. Jerry Pournelle awarded MICRO-SCOPE & POST-PROBE the User's Choice Award in the May 1994 issue of Byte Magazine, saying: "You name it, this tests it. If you maintain PCs you'll love it."

◆ LOW-LEVEL FORMAT—Performs low-level format on all hard drives including IDE drives. ◆ TRUE HARDWARE DIAGNOSTICS—Accurate testing of CPU, IRQ's, DMA's, memory, hard drives, floppy drives, video cards, etc. ◆ RELOCATES TRACK 0 on hard drives that support relocation. ◆ IRQ CHECK—Talks directly to hardware and shows I/O address and IRQ of devices that respond. ◆ O/S INDEPENDENT—Does not rely on O/S for diagnostics. Talks to PC at hardware level. All tests are full function regardless of O/S (i.e. Windows, Novell, UNIX, O/S2). ◆ IRQ DISPLAY—Show bits enabled in IRQ chip for finding cards that are software driven (Network, Sound Card, etc.). ◆ MEMORY DISPLAY—Displays any physical bit of memory under 1 MB. Very useful for determining memory conflicts and available memory space. ◆ AND MUCH MORE...We don't have enough space here for everything this software can do!

Govt. Orders: NSN-7030-01-421-6459

Call Now for Special Pricing
1-800-864-8008













Complete Micro-Scope Manual— easy to follow testing procedures and detailed error code descriptions. See the features list at left to view some of the incredible wealth of testing capabilities this program contains.

100% accurate results...

Tri-State Logic Probe—works
with Post-Probe and enables testing
down to individual chip level.

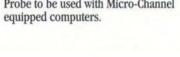
Durable Zip-up Leatherette Carrying Case—all your tools in one organized easy to carry toolkit.

Post-Probe Diagnostic Card—when Post-Probe detects an error, a 2 digit BIOS code will display on the card telling you exactly what's wrong with your PC. 100% compatible with all ISA, EISA, Compaq and Micro-Channel PCs.

NEW Optional Tutorial and PC Trouble Shooting Videos—Call for titles and current prices. A wealth of technical help at your fingertips.



Micro-Channel Adapter Card— (behind Post-Probe card) allows Post-Probe to be used with Micro-Channel equipped computers.





PC won't boot up? Find out why fast with our universal POST card...

"This is the only card that will function in every system on the market. The documentation is extensive, and not only covers the expected POST Codes for different BIOS versions, but also includes a detailed reference to the bus signals monitored by the card." —Scott Mueller from his globally recognized book, "Upgrading & Repairing PCs, Second Edition"

Includes pads for voltmeter to attach for actual voltage testing under load.
 4 LEDs monitor +5vdc -5vdc +12vdc -12vdc.
 Monitors Hi & Lo clock and OSC cycles to distinguish between clock chip or crystal failure.
 Monitors I/O Write and I/O Read to distinguish between write and read errors.
 Accurately monitors progress of POST for computers without POST codes.
 Reads POST codes from any IBM or compatible that emits POST codes. ISA/EISA/MCA.
 Compatible with Micro Channel computers.
 Dip switch allows easy selection of I/O ports to read.
 Includes TRI-STATE LOGIC PROBE to determine

actual chip failures. • Manual includes chip layouts and detailed POST procedures for all major BIOSs. • AND MUCH MORE...call for more details.

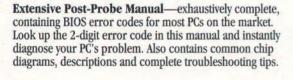
Govt. Orders: NSN-7025-01-421-6467

Micro 2000, Inc. Makers of Professional PC Diagnostic Tools 1100 East Broadway, Suite 301, Glendale, California, USA 91205 Toll Free: 800/864-8008 • Phone: 818/547-0125 • Fax: 818/547-0397 Web Site: http://www.micro2000.com

International Orders please call:

Circle 224 on Inquiry Card.













Capy Protection

Why use more and more developers WIBU-KEY to protect their software against piracy?

- Longevity: You could use a WIBU-BOX made in 1989 right now with Windows NT, which didn't exist 1989! Also you can run old software for DOS right now in a DOS box on Windows 95 or NT. Every WIBU-BOX comes with a full 3-year warranty.
- The most flexible security system for you, the programmer: Great Windows interface for programming WIBU-BOXes and protection of applications. Automatic detection of all WIBU-BOX variants at run time. Transparent and cascadable WIBU®-BOXes for LPT, COM and ADB, as well as PCCard and (E)ISA card. No special, expensive "network" dongle - the same WIBU-BOX works for single stations and on a network with programmable usage limits. Protect over 200 different applications seperately within one WIBU-BOX. One consistent API for DOS, Windows 3.x, 95, NT OS/2, MacOS and Networks, independent of the programming language.
- The most user-friendly security system for your customer, the end user: The WIBU-BOX is one of the smallest dongles available with a unique design and handling advantage for your customers. A powerful Control Panel applet provides easy installation and diagnostic tools for your customer. New sales or program updates can be handled by "Remote Programming" the WIBU-BOX on your customer's PC
- ✓ The most secure system: WIBU-KEY doesn't just do a quick check to see if the dongle is connected - it works by encrypting through our custom ASIC. Each encryption through the WIBU-BOX is initialized by a FEAL algorithm (block chiffre, 64 bit key). Each encryption has over 4 BILLION variants, chosen by a 32 bit selection code. The odds of cracking one program's encryption are 1 in 1050, and that process would get you no further on cracking any other program's encryption.



WIBU-KEY on stage at these events:

Munich, Germany October 21 - 25, 1996

Fall '96 S 2031 Sands Expo, Las Vegas November 18 - 22, 1996







Providing the highest quality Software Protection since 1989

We are happy to serve you:

IIDII **SYSTEMS**

Germany and International: WIBU-SYSTEMS AG Rueppurrer Strasse 54 - D-76137 Karlsruhe EL +49-721-93172-0 FAX +49-721-93172-22 BBS +49-721-93172-23 - CIS 100142.1674



Rortfin Technologies Inc. 1617 St. Andrew Dr. Lawrence, KS 66047 Tel. (800) 986-6578 + (913)832-2070 FAX (913) 832-8787 · CIS 71141,3624

Circle 225 on Inquiry Card (RESELLERS: 226).

Belgium, Lux.: COMPUSEC - Tel. +32-2-6450944 - Fax +32-2-6464266 - info@ Beigium, Lux.: COMPUSEC - let. +32-2-0490741 - 193 * -32-2-0407261 - info@compusec.be Croatia: ARIES D.o.o. Tel. +385-1-222752 - Fax +385-1-2226532 Estland: Lansoft Ltd. - Tel. +372-2-444760 - Fax +372-2-682760 - lansoft@infonet.ee Japan: Visual Networks Co. Ltd. - Tel. +81-3-34057801 - Fax +81-3-34057818 email: millet-vnee: Gyberoz.net Netherlands: COMPUSEC - Tel. +31-53-5740223 - Fax +31-53-5726822 - info@compusec.be

Pollution Solution.

This symbol identifies high performance energy-efficient computers, monitors and printers that save you money and reduce air pollution by

"powering

down" when not in use.

FPA POLLUTION PREVENTER

Be part of the solution. Start buying Energy Star^{s™} equipment today. To receive a list of available products, call the Energy Star^{s™} Hotline at 202 775-6650.



Buy It And Save.

INTERCON - PRODUCTS

PrintServers and PrinterPeripherals







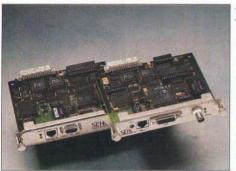






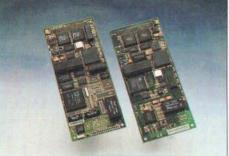






INTERCON-ETHER/TOKEN-HP-MIO

Printserver



INTERCON-ETHER/TOKEN-KYO-FS

Printserver

Multiprotocol support of

- SNMP (MIB II)
- NOVELL (IPX)
- UNIX (TCP/IP)
- Apple Ether/TokenTalk
- Windows NT (TCP/IP)
- · Windows '95 (TCP/IP)
- Windows for Workgroups



- · Ethernet 10Base2 (BNC), 10Base5 (AUI), 10BaseT (RJ-45)
- · Token Ring STP (IBM Typ1/2), UTP (IBM Typ3)

Printer / Plotter connections

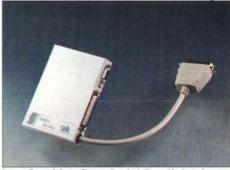
- · Interfaces for MIO V.5.x printers/plotters
- · Interfaces for KYOCERA FS printers
- · Interface for EPSON printers (Type B port)
- Interface for M-Tally MT350/360/380
- 2x Serial RS232 (Box-Versions)
- · 2x Centronics (Box), 1x Centronics (Pocket)



INTERCON-BOX / INTERCON-POCKET Printserver



INTERCON-INFRAPRINT IrDA Printer Adapter

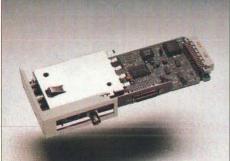


INTERCON-MULTIPORT Serial Parallel Adapter



INTERCON-ETHER-EPSON

Printserver



INTERCON-ETHER-MT

Printserver CS-Id:

Features

- · HTML configurable with Internet browsers like Microsoft Internet Explorer or Netscape Navigator
- · Multiprotocol support of all mentioned operating systems
- · Automatic recognition of the used network connector
- · Software update and upgrade via download in Flash-EPROM
- · Printer status request from host computer
- · Automatic protocol recognition
- · Configuration parameters can be edited by software
- · Automatic recognition and reaction to changes in the network environment
- · Supports 64 queues on 16 servers (Novell)
- · Easy installation via PCONSOLE (Novell)

More information about InterCon-Products

SEH Computertechnik GmbH, Germany Sunderweg 4 D-33649 Bielefeld +49/521/94226-0 Phone:

+49/521/444049 Fax: Internet: http://www.seh.de E-Mail: info@seh.de 100742,1452

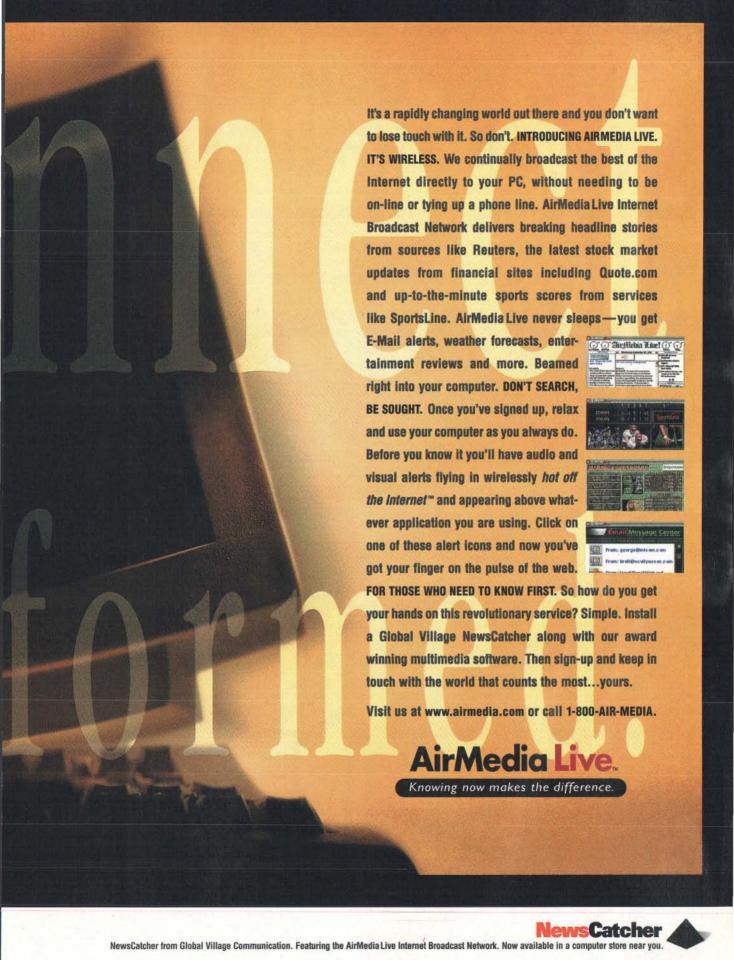


Computertechnik GmbH

Circle 227 on Inquiry Card (RESELLERS: 228).



AirMedia and AirMedia Live are trademarks of Ex Machina, Inc. NewsCatcher is a registered trademark of Global Village Communication, All other products are trademarks or registered trademarks of their respective owners. © 1996 Ex Machina, Inc. All rights reserved.



THIS IS YOUR FASTEST LINK TO THE INTERNET!



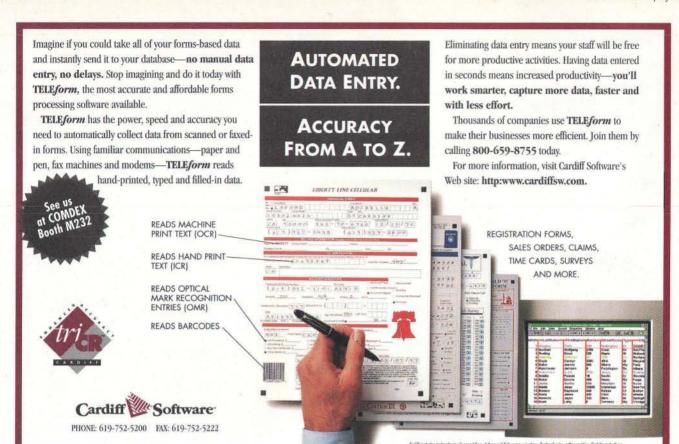




SUREAIR



Shipping not included. All returns must have RMA# and be in original condition. 30 day money back guarantee, minus shipping. 10% restocking, 7% cancellation fee. Orders charged, processed and tested prior to shipping. All logos are trademarks of their respective companies. Not responsible for typographical errors. 4100% Compatibility Guarantee involves certain restrictions, call for details. Hughes Network Systems Insight DirecPC, and Turbo Internet are trademarks of Hughes Network Systems, Inc.



Go From Paper To Electronic Forms

mips TransForm Suite™

The Total Solution for creating and using electronic forms.

Includes TransForm™. TransFill™ and WordFill™

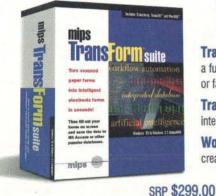
TransForm - Uses artificial intelligence and multiple OCR engines to redraw your scanned form into a fully editable vector graphic. Convert your paper forms to electronic forms in seconds by scanning or faxing them into TransForm.

TransFill - An MS Access based form filler. Set up complex calculations with an easy point and click interface. Save the data you've entered to TransFill's database or your own database for future access.

WordFill - The ideal solution for easily processing forms directly into MS Word. Import forms created or scanned in TransForm, including data-entry field information, straight into MS Word,

Automatically creates intelligent WYSIWYG form templates for use with MS Word for Windows and MS Access, ensuring compatibility with the most popular e-mail, routing and internet packages.

Supports calculations, range checking, data validation, look-ups, and multi-database look-ups with database attachments to Access, DBase, FoxPro, SQL Server, Paradox, Btriev, ASCII delimited, ODBC and many more.



Call mips at (800) 898-8560

Also available through:

EGGHEAD

800-EGGHEAD



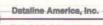
MicroWAREHOUSE* 800-367-7080

TigerSoftware 800-888-4437









Windows 3.1 & 95 Compatible

Tel: 619-679-4070 Fax: 619-679-4073 13240 Evening Creek Drive, Suite 311 · San Diego, CA 92128

INNOVATIONS FOR THE WORLD OF UNLIMITED POSSIBILITIES. · D COMDEX Please visit us at the FCLC booth at N232 Main Las Vegas **Convention Center** November 18-22, 1996

BOOST YOUR PRODUCTIVITY. INTRADISK™ FROM MRT.

If you communicate in open or closed networks, you will know all too well that the volume of information a network manages and the number of users connected have a significant effect on the access time to the data. Faster processors generally offer only a shortterm - and expensive - solution to this problem. But now things are changing! The new IntraDisk™ from MRT will meet both your current and future needs. IntraDisk™ pushes the specific information you require up to the surface. And unlike normal storage media, IntraDisk™ utilizes ultra-fast DRAMs, allowing you to access information 100 times faster. With an access time of under 100 µs, you can process up to 3300 I/O requests per second depending on the application. And thanks to

its modular design you can start at 128 MB and grow up to 1 GB per unit. See for yourself! IntraDisk™ is more

than just a storage device. It's a complete storage solution. Interested in finding out more about IntraDisk™?

Simply give a call, send a fax, e-mail us or visit our homepage. MRT micro Inc., USA, 8400 E. Prentice Ave. Suite 325, Englewood, CO 80111 - USA, Phone: +1303793 3660 or 888 MRT Sale, Fax: +13037933126, E-Mail Sales & Shipping: MRTUSA@aol.com, WEB site: http://www.mrt.no



Ideas with a future!

Keep Networks Safe from Viruses

Your network can spread viruses, but it can also help get rid of them. Here's how.

By Barry Nance

he movie *Independence Day* showcased some clever humans defeating aliens by planting a virus in the alien mother ship's computer. The ship—the biggest file server ever—suffered physical damage and crashed. Obviously, the aliens hadn't heard of antivirus software.

Couched in a large dose of poetic license, this entertaining

science fiction tale brings computer viruses to our attention yet one more time. Here on earth, computer viruses are a real threat to your data and your networks—but aliens aren't the culprits. Rather, a few individuals feel the need to distribute deliberately buggy software.

Viruses have been a problem for years, of course, but their threat is heightened today because of our growing interconnectedness. We now regularly share files on servers, download files from the Internet, and accept attachments to e-mail messages. Any one of these everyday activities can load buggy software into our computers. And no form of computer file seems to be immune. Java applets, ActiveX components, and word processing and spreadsheet files all can-and do-contain viruses.

Fortunately, there is help. A comprehensive backup

plan and centralized antivirus scanning can reduce viruses to minor annoyances.

Network Vulnerabilities

Encountering a virus is riskiest on a network because of the indiscriminate way that people share executable files and data files alike through the file server. Combine inadequate data backups and a virus that's allowed to go unchecked for a period of time, and the cost to your organization in lost data and wasted time can be enormous.



Most organizations encourage the use of antivirus tools, but virus awareness is often left for individual departments or remote offices to administer. This is a mistake. Centralized, enterprisewide virus detection and reporting are important, and for an important reason: An organization must know quickly whether it's dealing with an isolated virus incident so it can keep the cost

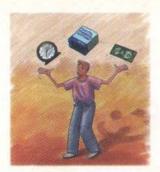
of antivirus measures commensurate with the level of threat. The most effective antivirus procedures are those that apply to an entire enterprise, use the organization's network to report any problems, distribute antivirus software updates over the network, and, via the use of log-in scripts, enforce the regular use of antivirus software.

But even before you can deal effectively with the problem by launching an enterprise-wide plan, you've first got to cut through all the vocabulary and euphemisms that have sprung up around viruses. Repeat after me: A computer virus is a buggy program that executes on the computers attached to your network. It's not a germ; viruses don't spread the way germs do. A virus simply copies itself through the file system on your computer or file server.

An antivirus utility does

not "inoculate" your system or "disinfect" your PC. It scans for known virus programs, removing buggy programs and their effects using normal file- or disk-management operations. And what seems like an "outbreak" is not a contagious epidemic, but rather the result of a virus reading your computer's clock and taking some sort of action (erasing files, perhaps) on a certain date.

A computer virus is not self-aware. When an unsuspecting victim executes a program containing a virus, the virus program or program segment copies itself to another program file. The



on Windows 3.1. Windows 95, and MINITAB Windows NT one product, Statistical Software. Master your data with ease.

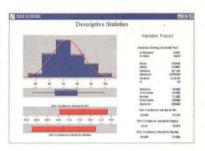
For over 20 years in over 80 countries, users have experienced the power and simplicity of MINITAB Statistical Software. Used in businesses from start-ups to Fortune 500 companies, MINITAB is:

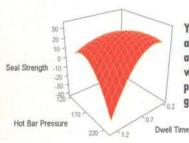
- · Powerful and comprehensive an "all in one" statistical software package from basic to complex statistical functions
- · Easy to use with dialog boxes and prompts every step of the way
- Easy for data entry or importing enter data into MINITAB worksheets or import data from Excel®, Lotus® and other programs
- · Ready to use right out of the box with MINITAB Statistical Software, there is no lengthy learning process and a simple and quick tutorial gets you working right away
- · Available on multiple platforms MINITAB Statistical Software runs on Windows® '95, Windows® 3.1, Windows NT™, Macintosh and Power Macintosh
- · Fully supported on-line HELP is easy and quick plus skilled technical specialists are just a phone call away
- · Affordable priced under US \$1,000
- · Guaranteed when you purchase directly from MINITAB, you receive our unconditional 30-day, money-back guarantee

Moving data between MINITAB and other packages, including Excel and Lotus is a breeze



With MINITAB's wide range of analytical tools, you have complete flexibility in analyzing your data.





Your data comes alive quickly and attractively with MINITAB's presentation graphics.



MINITAB has pull-down menus for all of its statistical capabilities. Just click and work with your data!

MINTAB STATISTICAL MINITAB Statistical Software runs on Windows '95, Windows 3.1, Windows NT, Macintosh and Power Macintosh.

NEW! Release 11 runs

one price!

Circle 153 on Inquiry Card.

To learn more about MINITAB, visit us on our Web site: http://www.minitab.com



Minitab Inc., 3081 Enterprise Drive, State College, PA, USA In Europe, call +44-(0)1203-695-730; Outside Europe, fax 814-238-4383.

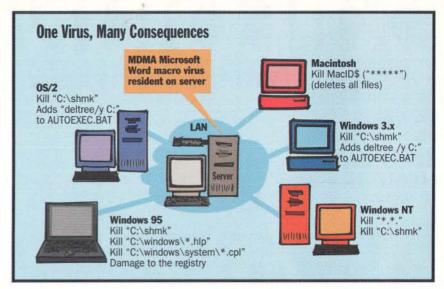
All product names are trademarks of their respective companie © Minitab Inc., 1996 MINITAB is a trademark of Minitab Inc.

To order MINITAB Statistical Software, call: 800-448-3555 814-238-3280 target program is typically an executable file, but it can also be the master boot record of the hard disk. The new copy of the virus in the infected program also inherits the ability to copy itself when run.

Some viruses do nothing else but make copies of themselves. Or they might simply display a message on a certain date. But others are not so benign—they strike by changing or deleting your files.

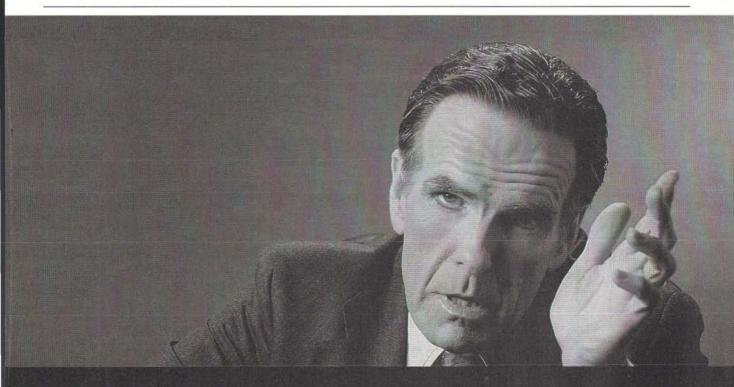
It's a popular misconception that viruses affect only DOS-based computers and that protected-mode systems, such as OS/2, NT, and Unix, are immune. But viruses can attack these OSes. Viruses designed to infect native OS/2 executables are more complicated to write than their DOS counterparts. However, dual-boot OS/2 systems that occasionally run DOS are subject to the thousands of DOS-based viruses. These buggy programs can alter boot records and DOS program files on OS/2-based machines.

In addition, we know of two OS/2 viruses: OS2vir1 and Jiskefet. OS2vir1 replaces all EXE files in the current directory with copies of itself. As a result, this



Once a macro virus, such as MDMA, infects a server, it can create cross-platform havoc throughout an organization.

virus is hard to overlook and thus does not spread very far. OS2vir1 displays messages identifying the files that it's replacing as it runs. Jiskefet replaces EXE files with a new file that contains the original EXE file. When the new, infected file is executed, it re-creates the original EXE file under



We sat through 5 big presentations in 3 days. All the people and equipment... a logistical nightmare.

EXPLORING...

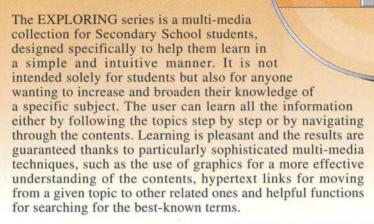
EXPLORING CHEMISTRY FOR WINDOWS

EXPLORING CHEMIS-TRY contains a large num-ber of topics, which include: the laws of chemistry; La-voisier, Dalton and Proust: the weighted balance of chemical reactions; matter; pure substances and mixtures; elements and compounds; atoms and mo-lecules; atomic models; the orbital quantum model and chemical bonds. It

is also possible to select the elements on the basis of their chemical and physical properties and to make a comparison of the data for several different elements by

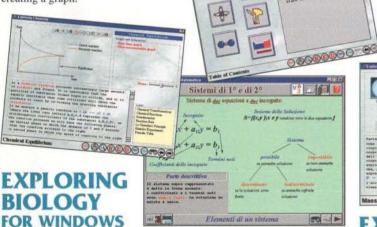
creating a graph.







EXPLORING PHYSICS is split up into several learning units covering the main topics of physics: the measurement of physical magnitudes; units of measurement; the analysis of experimental data; from the analysis of data to physical laws; speed, acceleration and force; equilibrium in stiff bodies and fluids; energy, temperature and heat; and electricity and the related phenomena.



Exploring Biology deals with a large number of topics that cover experimental analysis, scientific methodology, the instruments of scientific enquiry, the features underlying life, including the molecules that make up the structure of sugars, lipids, proteins and nucleic acids. The cell and its components, glycolisis, Krebs' cycle, cellular respiration, fermentation, chlorophyll related

photosynthesis, genetics, nucleic acids, DNA and RNA, DNA duplication, proteic synthesis, cell reproduction, Mendel's laws, sexual reproduction, modern genetics, genetic diseases, Darwin's and Lamarck's theories of evolution, proof of evolution, evolutive mechanisms, the origin of life, the classification of life-forms, the binomial list, classification criteria. The kingdoms into which living beings are divided are also dealt with: the Viruses, the Monera, the Protista, the Fungi, the Plantae and the Animalia.

MATHEMATICS FOR WINDOWS

EXPLORING MATHE-MATICS covers a range of many different topics: sets and their relationships, classes of equivalence, real and non-real numbers, operations and properties, algebraic expressions, monomials and polynomials, logical operations, equations and disequations, systems of equations and disequations and their performance, 1st and 2nd degree equations, radicals, parametric equations and biquadratic equations.



each title

Available in English, German, Spanish and Italian

MS-DOS and WINDOWS are registered trademarks of Microsoft Corporation



Via Montepulciano, 15 20124 Milano (ITALY) Tel. +39-2-66987036 Fax +39-2-66987027 E-MAIL: finson@finson.it

FINSON (UK) Ltd.
Parallel House - 32 London Road
Guildford - Surrey GU1 2AB
Tel. +44-1483-451856
Fax +44-1483-452144
E-MAIL: finson@finson.co.uk

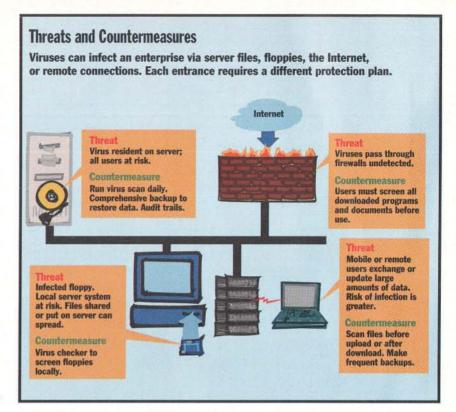
nore information and de http://www.finson.com

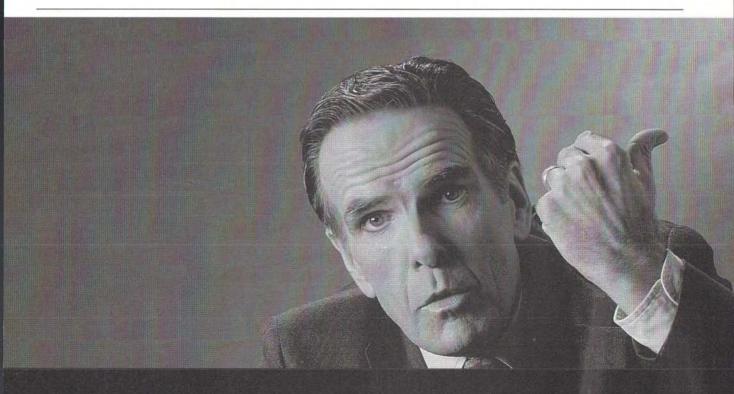
Minimum configuration: 100% MS-DOS compatible PC, CPU 80386 or higher, 4 Mb of RAM (8 Mb are recommended), hard disk with 6 Mb of available space, mouse, VGA graphic card or higher, Windows 3.1 or higher. Recommended: Windows compatible audio card, Windows compatible printer.

another name and then executes the original file. Jiskefet is not particularly effective at finding new files to infect. Similar viruses in the DOS world have never spread exceptionally well, which suggests that Jiskefet will not pose any significant threat to OS/2 systems.

Both Windows 95 and NT are fertile ground for the spread of DOS viruses, as well as viruses specially targeted for Microsoft's two latest OSes. Every unique OS requires individually tailored antivirus-protection software.

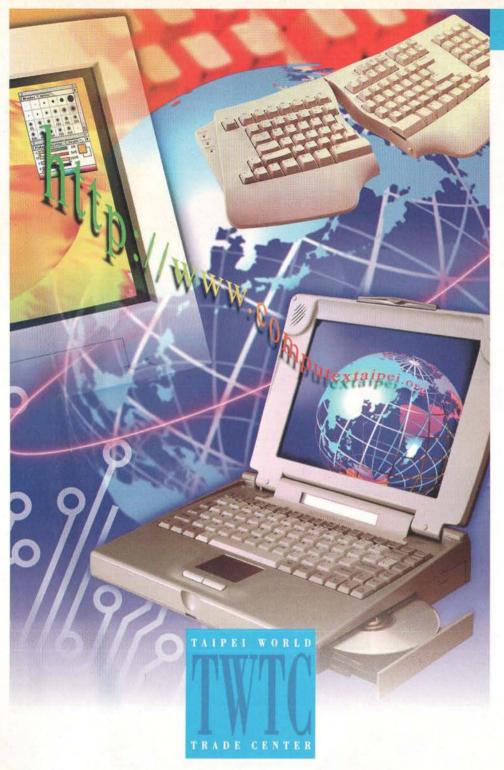
Viruses that infect files typically install themselves as memory-resident TSRs. Win 95 and NT support TSRs running in DOS sessions. These memory-resident viruses can infect new programs or floppies as they are used. Some file-infecting viruses fail in the NT (and OS/2) environment because they attempt to use undocumented and unsupported DOS features. A memory-resident virus can't spread directly between separate DOS sessions, but any program executed in a DOS session that's running a virus will likely become infected.





Then this guy walks in and only has two small bags, a laptop and what looks like *another* laptop.





COMPUTEX TAIPEI

THE 17TH TAIPEI INT'L COMPUTER SHOW

Circle 196 on Inquiry Card.

JUNE 3-7, 1997

Taiwan's IT exports in 1996 shall reach US\$ 25 billion, making it the third largest IT producer in the world.

Whether it's monitors, notebooks, mainboards, scanners, keyboards, mouse devices, CD-ROM drives or multimedia kits, there's hardly a sector where Taiwan is not a potent force. The future of 3Cs is closely intertwined with that of Taiwan.

COMPUTEX TAIPEI is your link to the world's most comprehensive IT sourcing center. COMPUTEX TAIPEI is also the entire world of Information Technology in microcosm, coming from Asia's technical leader.

To be on-line with the future, plug in COMPUTEX TAIPEI!.





Organizera:
China External Trade Development Council (CETRA)
5 Hsinyi Rd., Sec. 5, Taipei, Taiwan, R.O.C.
Tel: 886-2-725-1111, Fax: 886-2-725-1314
http://www.computextaipei.org



Taipei Computer Association (TCA)

Taipei World Trade Center Exhibition Hall Taipei Int'l Convention Center (TICC)



Taipei World Trade Center

For more exhibition information, please contact CETRA.

OS/2 programs use an executable file format that's different from that of ordinary DOS programs. A file-infecting virus that treats an OS/2 or NT executable file like a DOS file will likely render the target program inoperable. In some cases, starting an OS/2 program from within an infected DOS session will infect the program's DOS stub (the part of an OS/2 program that prints "This program cannot be run in DOS mode").

Word processor and spreadsheet macro viruses are nasty cross-platform problems. The destructive MDMA macro virus infects Microsoft Word documents and has the capability to delete files (see the figure "One Virus, Many Consequences" on page 169). Because this virus is application-based, it works across many platforms: OS/2, Windows, Win 95, NT, and the Macintosh. MDMA infects NORMAL. DOT as well as files that use the Auto-Close macro.

MDMA activates itself on the first day of the month. The result of an MDMA attack is different on different OSes. A typical effect: After the damage is done, MDMA displays the following text in a message box: "You are infected with MDMA_DMV. Brought to you by MDMA (Many Delinquent Modern Anarchists)."

LAROUX is a another macro virus; it infects Microsoft Excel spreadsheets. LA-ROUX replicates itself but does not destroy data. It has been reported by only one company, at sites in Alaska and Africa.

The LAROUX virus infects the PER-SONAL.XLS file, which is located by default in \MSOFFICE\EXCEL\XLSTART. PERSONAL.XLS is a default filename similar to NORMAL.DOT for Microsoft Word for Windows. If this file does not exist, the virus creates it.

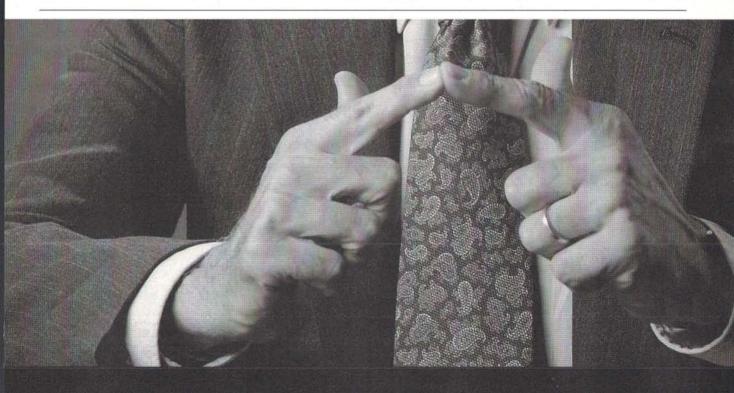
LAROUX uses two macros to replicate: auto_open and check_files. It infects Excel versions 5 and 7 on Windows 3.1, Win 95, NT, and OS/2. Because of the way it searches for PERSONAL.XLS (which is a DOS filename), the virus does not replicate on the Macintosh.

Viruses can spread on any system on which a program can create or modify another program. And they can spread between users anytime a program that one user runs can create or modify a program that another user can run.

Viruses aren't typically network-aware, but there are two notable exceptions. In November 1988, an Internet worm infected thousands of Unix-based machines that were connected to the Internet. And the CHRISTMA EXEC, a Rexx program for IBM's VM OS, produced millions of copies of itself on computers attached to European university networks, as well as IBM's own computers. In both cases, the network structure enabled the programs to spread rapidly in a matter of hours. Within a day or so, network administrators waded in, disabling the programs and cleaning up the mess.

Recommended Dosage

So how do you stop viruses from attacking your enterprise? Stopping your work every 10 minutes to run an antivirus utility is unproductive. But running such a utility just once every few years is a wasted effort. For most organizations, balancing safety and productivity means running antivirus software as frequently



I say, "Where's your presentation?" He just smiles, plugs them together and BOOM... he blows us away!



QUANTUM PHYSICS, TERM OR LIFE.
THE INFIELD FLY RULE, CONVERGENCE,

Ah, we knew that last one would confuse you.

But then, which of life's complexities is tougher to decipher than the Convergence market?

Where the need for expert Information Technology solutions turns every decision into a Pass/Fail test.

It can all seem overwhelming. Until you discover something nearly one million computing experts already know. It's called BYTE, and within its pages are the answers and insights IT decision-makers trust to make Convergence a reality instead of a nightmare.

Now, we're not saying BYTE can unravel all of life's mysteries. But if your company is in the Convergence market, or advertising to it, you'll find no one is more of an authority on the subject.

The Infield Fly Rule? Hey, your guess is as good as ours.

 ∇



Why do nearly one million computing experts worldwide read BYTE magazine every month? Because only BYTE delivers the global coverage and technical insights that illuminate Information Technology from problem through solution. That makes us something of an authority on the subject. And you something of a genius when you advertise in BYTE. For more information, call John Griffin, VP/Publisher at 603.924.2663. Or contact us at http://www.byte.com

THE GLOBAL AUTHORITY FOR COMPUTING TECHNOLOGY.

as once a day or as little as once a week. If your employees frequently use floppies or other uncontrolled media to transport data, running such a utility daily makes sense (see the figure "Threats and Countermeasures" on page 171).

Unfortunately, the majority of antivirus programs are outdated even before you install them; IBM estimates that up to five new viruses are written each day. Updates thus form an important part of any antivirus policy. A typical organization should plan to update its antivirus software at least every quarter. To remind you of your potential exposure, many antivirus programs will announce their staleness when a certain date is reached. Distribute updates soon after the utility displays its out-of-date message, but let users know that it's OK to run a utility that claims it's a few months out of date. Be sure to distribute updates to all your sites on a timely basis.

You should require 100 percent compliance with your antivirus procedures. If you achieve 90 percent, then you will have a fairly effective antivirus program in place. If your network OS (NOS) is NetWare, consider running the antivirus utility in NetWare's system log-in script. Each computer will then scan for viruses every time a user logs on to the network. DOS, Windows 3.1, Win 95, the latest version of NT, and OS/2 all support NetWare log-in scripts.

No Immunity

Inevitably, every organization will encounter a virus problem. Networked computers, especially those running DOS or Windows, are most at risk. Networks allow viruses, the majority of which are DOS-based, to spread quickly.

However, no computing environment has a natural immunity to viruses. A good backup of your data, along with an aggressive enterprise-wide antivirus strategy, is inexpensive insurance.

Barry Nance, a BYTE consulting editor, has been a programmer for 25 years. He is the author of Using OS/2 Warp (Que, 1994), Introduction to Networking (Que, 1994), and Client/Server LAN Programming (Que, 1994). You can contact him at barryn@bix.com.

WHERE TO FIND

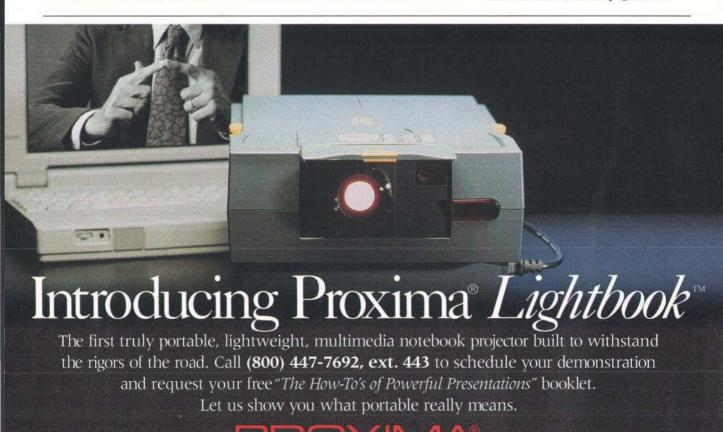
Cheyenne Software Roslyn Heights, NY (516) 484-5110 fax: (516) 484-3446 http://www.chey.com

IBM Armonk, NY (914) 765-1900 http://www.ibm.com Intel Corp. Santa Clara, CA (408) 765–8080 http://www.intel.com

McAfee Associates Santa Clara, CA (408) 988-3832 fax: (408) 970-9727 http://www.mcafee .com S&S Software International, Inc. Burlington, MA (617) 273-7400 fax: (617) 273-7474 http://www.drsolomon.com

Symantec Corp. Cupertino, CA (408) 253-9600 http://www .symantec.com TCT-ThunderByte Corp. Cornwall, Ontario, Canada (613) 930-4444 http://www .thunderbyte.com

Touchstone Software Huntington Beach, CA (800) 531-0450 http://www.antivirus .com



http://www.prxm.com • Main Office: 9440 Carroll Park Drive, San Diego, CA 92121-2298 • (619) 457-5500 FAX: (619) 457-9647
Proxima is a registered trademark of the Proxima Corporation, Lighthook is a trademark of the Proxima Corporation. Other trademarks are property of their respective owners.

MULTIMEDIA PROJECTORS



THE 1996 MICROGRAFX CHILI FOR CHILDREN COOK-OFF TUESDAY, NOVEMBER 19, 1996 • 6 PM - 11 PM • THOMAS & MACK CENTER (UNLV)

Let yourself go at this year's Micrografx Chili for Children Cook-Off—COMDEX/Fall's premier charity event.

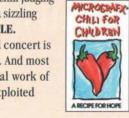
It's a zesty mix of fun, fun, fun—with chili judging and armadillo races, all topped off with a sizzling concert by BTO and the VILLAGE PEOPLE.

Your ticket to the Chili Cook-Off and concert is only \$50 - or \$25 for the concert alone. And most important, it all goes to support the vital work of the National Center for Missing and Exploited Children (NCMEC).

For ticket information, call the Chili Hot Line today at 1-800-357-7255. Or visit our red-hot Chili Web Page

> at http://www.micrografx.com/chili.html or drop into the Micrografx Chili for Children Booths at LVCC and Sands Expo Lobby at COMDEX/Fall. What's more, mention this ad and you'll get \$5 off the concert admission only.

> So come on out and dance the night away. You'll have a great time, and you'll help us all go a long way towards helping missing children.





1996 CATTLE BARON SPONSORS

















Comparison

New versions of PowerBuilder and Centura offer improved performance and faster 32-bit applications. By Mark Hettler

Upgraded C/S Tools: How Much Better?

arlier this year, we compared Borland International's Delphi Client/Server Suite, Microsoft's Visual Basic 4.0 Enterprise Edition, Powersoft's Power-Builder Enterprise 4.0, and Gupta's

SQLWindows 5.0 (see "New Leaders of

POWERBUILDER 5.0

RATINGS

TECHNOLOGY

IMPLEMENTATION

* * * * *

PERFORMANCE

* * *

the Client/Server Migration," June BYTE). Since then, Powersoft has released PowerBuilder 5.0, while Gupta has changed its name to Centura Software and issued Centura Team Developer 1.0. These products are so improved that we considered it important to look them over and update our previous ratings based on the new capabilities.

Both of these packages are development tools for creating custom, standalone client/server applications that let users enter, sort, filter, and report on your organization's data according to your business policies, procedures, and data operations. As in June, we tested these products for performance, usability, and versatility, using each one to develop an order-entry-system database of books, authors, and customer orders. With our test applications, users browse a database of 50,000 existing orders, enter new

orders, and run simple and complex reports.

In our tests, PowerBuilder and Centura come out close together. PowerBuilder is a little easier to use and a little more powerful, but Centura builds better-performing applications more quickly. In the June review, Delphi showed itself to be several times faster than Visual Basic, which in turn was several times faster than its other competitors. Centura and PowerBuilder have narrowed the gap, but Visual Basic is still a solid second.

Using NSTL's overall ratings scheme, Centura's greatly improved performance and PowerBuilder's much better versatility move both products within striking distance of Visual Basic. In fact, on the 1-to-10 scale we use, a mere 0.2 delta separates the three runners-up. Though it's a good performer, Visual Basic is clearly on a tier below the other three products in terms of features. Delphi, though it has the steepest learning curve, is still the performance and features champ.

PowerBuilder Enterprise 5.0

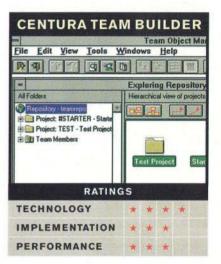
ADVANTAGES

- + Integrated version-control system that's remarkably easy to set up
- + Excellent support for three-tiered client/ server applications that communicate with one another

DISADVANTAGES

- Repository platform requires Sybase's SQL Anywhere
- Improved performance still lags behind the competition

Most of the features and architecture that have made PowerBuilder popular are still in place in version 5.0. You still use interfaces called *painters* to create the various parts of applications, and DataWindows allow easy implementa-



tion of database access. InfoMaker, the report generator, looks and feels much the same as in PowerBuilder 4.0, but it's now available as a 32-bit application. Developers can create reusable components called *user objects*, which can be based on built-in components or other user objects and inherit their properties.

Beyond the familiar features, however, version 5.0 moves the product into the next generation of client/server development by introducing support for a three-tiered architecture. This capability is already available in Visual Basic and Delphi, but PowerBuilder is the best of the three products at providing step-bystep instructions for developing client and server applications that communicate with each other. Powersoft introduced nonvisual user objects in version 4.0. It extended the capability in version 5.0 to allow the nonvisual objects of one program to be executed by another.

Users familiar with PowerBuilder's Library Painter will go through virtually no additional learning curve with the new version-control system, ObjectCycle. Once you set up an ObjectCycle Server, you simply register the contents of a

* Poor

library with ObjectCycle. From that point, you check components in and out as in earlier versions. Setting up the ObjectCycle Server is effortless. This is amazing given that the system must create a client/server database to store project data.

Centura Team Builder 1.0

ADVANTAGES

- + Much improved performance
- + Allows building of 32-bit applications
- + Data repository uses Oracle, Microsoft, Sybase, or Centura databases

DISADVANTAGES

- Features and versatility are little changed
- Application Server for three-tiered applications is not yet available
- Need to manually edit configuration files

The company that was formerly known as Gupta has adopted a completely new identity, renaming both its flagship software package and the company itself. Inside the new package, however, Centura Team Builder is essentially a version upgrade of SQLWindows. You still develop applications by writing code in the familiar Outliner interface, using the same SQLWindows Application Language (SAL) commands and functions that earlier versions used.

Developers can avoid the Outliner to a large degree by using QuickObjects, which generate forms and other objects automatically based on input supplied by the developer. This isn't a new feature, however, having been introduced in SQLWindows 5.0. The Team Object Manager is essentially Team Windows with a new user interface. Centura's much-touted Application Server, the tool for developing three-tiered applications, won't be available until later in the year.

The earlier version's annoying details are also still in place. To enable access to remote databases, you must still edit configuration files manually. Team Object Manager, like the earlier Team Windows, still leads the field in maximizing the power of the client/server environment for repository-based applications management, but it's still poorly integrated with the main development interface. Also, while QuickObjects produce applications and components more quickly than writing code in the Outliner, it is difficult and confusing to change properties after you generate them. continued

PowerBuilder vs. Centura

You can access the full data, including Delphi and Visual Basic 4.0, complete with individual weightings and scores in each category and line item, on The BYTE Site (http://www.byte.com/).

	PowerBuilder	Centura
FORM DESIGN		_
Visual query builder Query by form	7	
Quick form from database table	-	~
Move fields after generating	,	-
Quick master-detail form	~	~
Multiple record display	~	-
APPLICATION-CONTROL FEATURES		
Dynamic menu building		~
Multitab dialog boxes	~	~
orm can call another form	~	~
EVENTHANDLING		
Procedures triggered by events	V	~
Detect keystroke/mouse-click/time event	~	~
Process based on old or new value	~	V*
Cancel any event	~	~
ADVANCED FUNCTIONS		
ncorporate VBX and ActiveX controls	~	~
OLE 2.0 edit-in-place	~	~
Store OLE objects in database	~	~
SQLSUPPORT		
Generic SQL		7
Engine-specific native SQL	~	-
Fransparent joins across engines		THE REAL PROPERTY.
REPORT GENERATOR		
ncorporate report into application		7
Quick report within application	~	
Specify selection criteria, sort order at run time Event procedures	7	7
Multiple records across page		-
APPLICATION REPOSITORY	~	~
Store application components and reusable objects		
Store multiple versions	~	V
Store form/report templates	~	~
WORKGROUP FEATURES Check out/check in	~	~
Built-in version control	~	~
Version control of external files	-	~
REMOTE AUTOMATION		
Produce remote programs	~	
Call and exchange data with remote programs	~	V
Remote procedures can access database	~	
Call in-process OLE server	~	V
Call out-of-process OLE server	~	V
Produce in-process OLE servers	~	
DBJECT MANAGEMENT	/- II 12 12	
Copy objects between applications	~	~
Copy code snippets between applications		~
Reusable object classes	~	~
Subclasses with inheritance	~	~
Multiple inheritance		~
Directioning status and a few database		
By retrieving status codes from database. ✓ = ye	25	



In an uncertain world,
it's nice to know that
sunrise and sunset are
not the only things
you can depend on.

(6) If you have multiple or remote sites, you can't do better than Reflection⁸ Suite for TCP/IP. It has more features and better management tools than the free stacks do. It offers a broad range of functionality you can depend on — no matter what.))

Grant Easton, Technical Consultant, Hewlett-Packard Co.

Reflection Suite for TCP/IP

- **▲ UNIX, DIGITAL, IBM MAINFRAME, AND AS/400 CONNECTIVITY**
- ▲ CLIENT/SERVER, NFS, AND TCP/IP DESIGNED FOR OPEN STANDARDS
- REMOTE/MOBILE OPTIMIZATIONS, WINDOWS 3.1X, 95, AND NT VERSIONS AVAILABLE, INTRANET/INTERNET APPLICATIONS
- ▲ EXTENSIVE NETWORK DIAGNOSTICS, TROUBLESHOOTING, AND ADMINISTRATIVE TOOLS, PLUS SIMPLIFIED SETUP
- ▲ FREE, ONGOING TECHNICAL SUPPORT VIA TELEPHONE AND ONLINE SERVICES



http://www.wrq.com A E-mail: info@wrq.com

For a FREE demonstration copy, call your authorised Reflection distributor

Argentina-TCW Argentina S.A. (1) 314 5010 Australia-Megatec Pty, Ltd. 1 800 806 563 Austria-SIS Informationstechnologie Ges.m.b.H (01) 368 65 00 112 Benelux-BMC Software Services (070) 416 57 57 Computing & Systems Consultants by (040) 23 33 555 Brazil-Nutec Informática S.A. (011) 5505 5728 Chile-S & A Consultores (2) 235 0289 Czech Republic-INSEKO CS (067) 607 311 Denmark-Tempest A/S 4494 8902 Finland-TT-Professional Solution Oy (90) 3294 7600 France ADE (Toulouse) (16) 61 00 32 32 Germany-Computing & Systems Consultants GmbH (0211) 53 70 01 6 Wick Hill Kommunikationstechnik GmbH (040) 23 73 01 0 Hong Kong-Global Technology Integrator Ltd. 2881 4800 Indonesia-P.T. Summitra Solusindo (021) 659 8886 Ireland-Entropy Ltd. (01) 2940199 Israel-Yana Systems Ltd. (03) 557 3636 Italy-Siosistemi srl (030) 24411 Japan-Cybernet Systems (03) 5978 5453 Malaysia—SCS Computer Systems Sdn. Bhd (03) 756 5800 Advantage Systems Sdn. Bhd (03) 703 3166 Mexico-Infosistemas Financieros (5) 813 1325 New Zealand-Interconnect (09) 358 0322 Norway-NOCOM Norge A/S 67581450 Poland-Softkom Sp. z o.o. (22) 624 34 50 Portugal-Silicon (01) 795 85 85 Singapore-MicroAsia Pte. Ltd. 441 2600 Slovak Republic-INSEKO a.s. (089) 64 88 08 Slovenia-SI d.o.o. (061) 161 11 57 South Africa-LAN Design (011) 239 5000 Spain-Scorpion Sistemas S.A. (93) 485 40 44 Sweden-NOCOM AB (018) 65 55 00 Switzerland-Commoare AG (01) 730 24 31 Taiwan-Ivan Information Technology Co. (02) 517 7012 Thailand-MultiLink Co., Ltd. (2) 318 8505-7 United Kingdom-Wick Hill Limited (01483) 772280 Venezuela-Lanka Sistemas (2) 959 2411



WRQ makes PC software that connects users to enterprise computers and information networks—UNIX, X, HP, Digital, AS/400, IBM Mainframe & TCP/IP.

TECH FOCUS

VERSION CONTROL

New Versions. New Controls

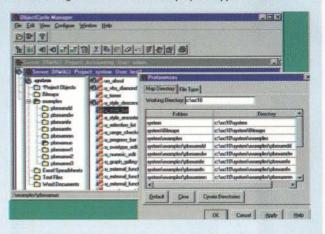
In any development environment that involves more than one person, the issue of version control (sometimes called change control) becomes critically important. As a software project evolves and grows, you add and change routines and modules, requiring recompilation, relinking, and resynching of some or all of the executable files.

Both PowerBuilder Enterprise and Centura Team Developer include facilities for version control, and both use client/server database technology to create and manage a shared, central object repository. Centura's Team Object Manager lets developers choose from Oracle, Microsoft, Sybase, or Centura databases for a repository platform, while PowerBuilder's ObjectCycle requires Sybase's SQL Anywhere.

Object-based systems must store many types of objects together with their properties and histories, including windows stored in libraries, menus, ActiveXes, bit maps, icons, DLLs, and even Word documents. Centura Team Developer features a graphical class browser that visually describes inheritance relationships among objects and classes, management reports that detail where an object is used in an application, ownership information on objects, the assignment of separate roles to team members who function as class engineers or object assemblers, version control of objects, and much more. PowerBuilder has ObjectCycle Manager (see the screen at the right), a graphical interface to the ObjectCycle Server that provides administration of PowerBuilder objects and projects, and version control for non-PowerBuilder objects. Centura's Team Object Manager supports project branching (e.g., running development for versions 1.1 and 2.0 concurrently), coding standards management, deployment management,

impact analysis, audit trails, and management reporting.

Important tasks related to version control include the administration of multiple platform versions, configuration information, build management, quality control, and release management. Both companies claim that their version-control facilities are up to the complete task. For example, PowerBuilder has a build process that's quite different from that used in a C or C++ environment. Third-party tools have only a limited ability to handle such product-specific, cross-tool builds, and that can limit their usefulness and versatility. Centura has a build management feature with which you can specify how different files come together to constitute a deployable application.



With all these holdovers, why did we bother with Centura? Its major new feature is that it now supports the development of 32-bit applications, a change that significantly improves performance (see the section below). In addition, the package incorporates Centura Ranger for database replication. Many leading database vendors (e.g., Oracle, Sybase, and Microsoft) support replication. Centura's strategy is to approach the issue from the client

PRODUCT INFORMATION

Centura Team Developer 1.0 \$4995 (486 or better 8 MR of RAM, 80 MB of disk space, Windows 95 or Windows NT) Centura Software Corp. Menlo Park, CA (800) 444-8782 fax: (415) 321-5471 http://www .centurasoft.com Circle 1004 on Inquiry Card.

Enterprise 5.0 \$2995 (486 or better 12 MR of RAM [16 MB is recommended], 32 MB of disk space, Windows 3.1x, Windows 95, or Windows NT) Powersoft Corp. Concord, MA (800) 395-3525 (508) 287-1500 fax: (508) 369-8639 http://www .powersoft.com Circle 1005 on Inquiry Card.

PowerBuilder

side, providing heterogeneous replication between a variety of database formats. At present, however, it supports only SQL-Base and Oracle databases; replicating Oracle databases requires buying an additional product from Centura.

Performance

NSTL ran PowerBuilder 5.0 and Centura Team Builder through the same benchmark suite used in the June review, with the identical configuration: We executed applications on a Dell Dimension XPS P90 with 24 MB of RAM running Windows NT 3.51, accessing a Microsoft SQL Server database. This allowed us to compare the results directly to those of the June review, where PowerBuilder and SQLWindows trailed Delphi and Visual Basic by significant margins.

Both products are markedly faster, but Centura is by far the more significantly improved. This is due largely to its 32-bit capability; the previous 16-bit version was at a disadvantage to the other three products in the earlier review. However, data retrieval is dramatically improved as well. The time to retrieve a 50,000-record data set is 80 percent shorter. Report generation takes a third less time for a complex report, more than half for a simple report. These improvements are enough to move Centura ahead of PowerBuilder, though it's still well behind Delphi and Visual Basic.

PowerBuilder has introduced a new machine code compiler. By Powersoft's own admission, however, the benefits for such operations as data retrieval and screen drawing—which are, after all, the central facets of an on-line database application—will be minimal at best.

Nonetheless, PowerBuilder 5.0 shows a consistent 20 percent to 30 percent increase over version 4.0 on most of the tests. Report execution times are reduced by more than a third, largely because the Info-Maker report generator is now a 32-bit application.

In the final analysis, PowerBuilder beats Centura (despite the latter's improvements), and neither beats Delphi for features and performance.

Mark Hettler is a senior technical editor at NSTL. You can reach him at markh@nstl.com.

Review

ObjectGeode, an OO CASE tool for real-time development, is a suite of tools based on accepted standards. By Rick Grehan

Real-Time RAD

bject-oriented (OO) CASE tools have been notoriously deficient when applied to real-time applications. Now, Verilog's ObjectGeode, with its triad of interwoven editors, will take on this real-world challenge.

Opponents of generic OO methodologies complain that they are not effective in modeling the asynchronicity, concurrency, and distribution of real-time systems, and that typical OO CASE tools provide no formal connection between abstract models and programs.

Consequently, ObjectGeode has some rapids to cross. It does so by lashing together a collection of tools based on well-accepted standards.

Editors, **Editors**

I tested ObjectGeode on a SparcClassic running Solaris 2.5. It is also available for SunSparc, Hewlett-Packard Series 9000/7xx-8xx, IBM RS/6000 and PowerPC, and DEC Alpha/OSF1.

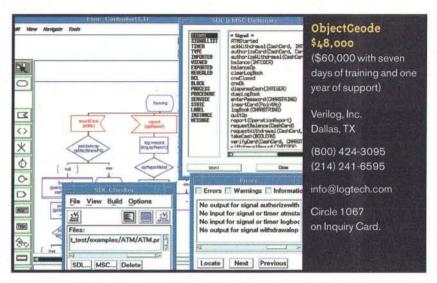
At ObjectGeode's core are three editors: object modeling technique (OMT), specification and description language (SDL), and message sequence chart (MSC). The OMT editor is sometimes referred to as the class diagram editor. Each editor's notations are based on

RATING	S	- V	- 121		
TECHNOLOGY	*	*	*	*	2
IMPLEMENTATION	*	*	*	*	
PERFORMANCE	*	*	*	*	

widely accepted standards: SDL and MSC are standard notations in the telecommunications industry. OMT is the well-known technique developed by James Rumbaugh and others.

The OMT Editor

This editor allows you to build class and instance diagrams using OMT notation.



ObjectGeode's SDL editor allows you to design finite state machines and will generate source code.

From within the OMT editor, you make sets of modules, each module being a particular view of the system. Typically, you create an overall view of the system to identify the principal actors (i.e., objects) and then construct other modules that describe those actors in increasing detail.

Diagrams you construct with the OMT editor are necessarily visual and fall into two categories: class diagrams and instance diagrams. Class diagrams show the internal structure (i.e., data items and methods) of-and relationships between-the system's objects. For example, if you are designing a system to control a bank's ATMs, you would use a class diagram to define what's inside the system's notion of a bank object and how that object relates to a customer object. Instance diagrams illustrate how a particular set of instances derived from the system's classes might be logically connected to one another.

ObjectGeode can generate C++ code from the modules you create in the OMT editor. This code is really C++-styleheader files containing class declarations filled with variable definitions and method prototypes. You can't use the OMT editor to specify the details of a given class's methods.

The MSC Editor

You turn to the MSC editor to diagram each use case, which is like the script of a play. You can read use-case diagrams to determine the actions that unfold as the system operates.

Other methodologies call use cases usage scenarios or event traces. But Object-Geode scenarios refer to high-level event descriptions that are separate from the low-level details of the event. Thus, a scenario might be shown as a block labeled SCSI read in an MSC diagram, while the MSC would be the chart detailing the steps of the read operation.

It's important to note that the charts you build with the MSC editor show discrete activities, so you cannot use it to model the entire behavior of the system. Additionally, MSCs show the *expected* behavior of the system—what the system is supposed to do, not how it does it.

Use cases are helpful in determining derived requirements of objects. In other words, working out the use case for a particular event may reveal an attribute that was omitted from an object participating in that event. It's a two-step process. First, you identify the functions the system must perform; next, you work through the details of the lowest-level activities.

The SDL Editor

ObjectGeode's SDL editor is a combination of three editors: a hierarchy editor, an interconnection editor, and a finite-statemachine (FSM) editor. The hierarchy editor is similar to one found in the MSC editor and is likewise a means of grouping similar activities.

With the interconnection editor, you can model communication between objects in the system like in a wiring diagram. It's easy to get confused here, because you're likely to conclude that objects in the SDL editor are the same as those you built in the OMT editor. This is not so, and the distinction is revealed once you understand ObjectGeode's design process. Simply put, you use the OMT editor in the problem domain and the SDL editor in the solution domain. Thus, SDL editor objects are often artifacts—objects that are constructed to solve the problem outlined in the OMT editor.

You program the machinations of the

processes themselves visually, using the FSM editor. From a distance, you could mistake the FSM diagrams for flowcharts, which in a sense they are. FSM diagrams reveal how SDL processes work.

The Process Process

Working through a project with Object-Geode does not mean moving among editors sequentially. Rather, you visit the same editor multiple times. The overall process goes something like this:

Requirement-analysis phase. Using the OMT editor, you work out major classes based on real-world objects, identifying class attributes, methods, and relationships. In use-case modeling, you use the MSC editor to outline what the system should do, grouping cases into scenarios and defining messages between objects.

Architectural design. You introduce objects that will participate in the solution, avoiding specifics. Much of this happens in SDL. The focus shifts from objects to processes. The interconnection editor lets you map out how processes communicate with one another, thereby revealing the architecture of the system.

Detailed design. At this point, you use the FSM editor to begin working out the details of processes. Once you have the state machine of a process specified, you generate SDL code and run it in simulation on an SDL engine. This lets you catch such problems as deadlocks and unexpected signals. You can also backfill missing details in the OMT class diagrams that preceding phases have revealed.

Test design. You refine the MSCs produced in the requirement-analysis phase to construct detailed message sequences that exercise all possible scenarios. When running an SDL simulation, ObjectGeode will generate MSCs and match them with those specified. You can also create failure MSCs—message sequences that, if executed, indicate a failure of the system.

Targeting and testing. These phases convert the working SDL models to executable code. The conversion is straightforward, but it requires an SDL virtual machine on the target system. Virtual machines exist for a number of popular real-time OSes (RTOSes), including pSOS, VxWorks, and Vertex.

Good, Bad, and Ugly

ObjectGeode has competitors, most notably the real-time object-oriented modeling (ROOM) tool suite called ObjecTime (see "Systems Design in ObjecTime," December 1995 BYTE). Additionally, real-time projects have used the Shlaer-Mellor object-oriented-analysis (OOA) method, which is supported by development tools from Project Technology.

ObjectGeode's indisputable advantage is its use of standard notational languages and methodologies. This saves you from having to learn concepts that aren't applicable elsewhere.

Its use of SDL as the procedural notation provides a measure of portability. Not only can you target a variety of RTOSes, you can also deploy a single SDL model on different topologies (e.g., the same model can produce code for both single-processor and multiprocessor systems).

On the downside, ObjectGeode suffers from the difficulties in applying general-purpose OO-modeling methodologies to real-time systems, such as requiring translation "by hand" of items specified in the OMT and MSC notations into final code. ObjectGeode therefore can't provide a complete model-to-code solution. Contrast this with ObjecTime's ROOM, which uses an executable notation.

The pricing is steep as well. The software suite we tested costs \$48,000 (\$60,000 adds seven days of training and maintenance support for one year). The different components of ObjectGeode are available separately, and there are discounts for quantity purchases.

Rick Grehan is a senior technical editor for BYTE reviews. You can reach him at rick_g@bix.com.

TECH FOCUS SYSTEM TYPES

What's an Asynchronous System?

ObjectGeode addresses one class of real-time systems: asynchronous systems—those that service nonperiodic events. An example of an asynchronous system is a telecommunications switching system; there's no way for the system to predict when you'll pick up the phone. It's no surprise, then, to find that many of ObjectGeode's customers are in the telecommunications industry.

The other class of real-time systems—synchronous—deals with events or signals that arrive within a known period. (The dichotomy is not rigid. Plenty of real-time systems have both synchronous and asynchronous characteristics.) Synchronous systems also tend to be "hard real time" in nature. That is, not only do the events occur with known regularity, the system must service them in a specified amount of time. An example of a synchronous real-time system is a stepper-motor controller. Signal pulses must be transmitted to the motor at a certain frequency, or the motor simply won't step.

Designing a synchronous real-time system amounts to determining how many events will arrive at the system and at what frequency, and deploying tasks (or threads) to handle each event. The developer then explores worst-case scenarios to determine, for example, whether there would be enough horsepower to service events if they all arrived simultaneously.



Do more with less.

Most operating systems leave little room for important things. Like your application.

With the QNX realtime OS you'll pack more functionality into less memory. Achieve more performance with less-expensive CPUs. And deliver better solutions at a lower price.

Better yet, QNX supports more PC hardware than any other realtime OS. Whether it's PC/104 or PCMCIA, embedded X86 or the Pentium® Pro, QNX lets you use it right out of the box. Get to run time in less time!

More scalable than ever! From low-end to high-end, QNX offers you the ultimate in scalability. Even your deeply embedded systems can boast a scalable POSIX RTOS, thanks to our new, exceptionally small Neutrino" microkernel.

And if you need to add the capabilities of a high-end GUI to your low-end system, you can. Our award-winning Photon microGUI^{**} gives you a phenomenal front end, with enough memory left over for important things . . . like your application!

www.qnx.com

Call 1 800 676-0566 (ext. 1028) or email info@qnx.com



QNX Software Systems Ltd., 175 Terence Matthews Crescent, Kanata, Ontario, Canada K2M 1W8 Voice: 613 591-0931 Fax: 613 591-3579 **Europe:** 49 Dove Park, Chorleywood, Hertfordshirë. Voice: (44)(0)1923 284800 Fax: (44)(0)1923 285868 Email: QNXeurope@qnx.com

© QNX Software Systems Ltd., 1896, QNX is a registered trademark and Neutrino and Photon incroßUl are trademarks to GNX Software Systems Ltd., 481 other trademarks the Systems Ltd., 481 other trademarks the Systems Ltd., 481 other trademarks the Systems Ltd.,

Iomega's Ditto 2GB tape drive can back up all your data on a single cartridge—albeit slowly. By Robert L. Hummel

Ditto Your Data

ape backup was once a murky, quirky domain where technicians tended expensive, proprietary black boxes. Today, ease of use and low prices make tape backup a sizzling consumer-oriented aftermarket. Iomega's latest entry into this pageant, the Ditto 2GB External, continues the trend toward higher-capacity media, lower-priced drives, and user-friendly software.

As the size of the average hard disk has swollen to epic proportions, so has the chance of data disaster. Given the cost of re-creating even a single complex file, personal tape-backup devices, such

Ditto Data

Interface: Parallel port (with printer pass-through)

Read compatibility: QIC-80, QIC-80W, QIC-3010, and QIC-3020; Trayan TR-1, TR-2, and TR-3

Writes: Preformatted lomega 2GB only

Native capacity: 1 GB Cartridge cost: Less than \$20

as the Ditto 2GB drive, are increasingly attractive.

Measuring 5.4 by 1.6 by 7.6 inches, the Ditto 2GB drive easily finds a home on a crowded desk. It connects to a parallel port (with printer pass-through), and it's eminently portable, weighing in at a svelte 1.4 pounds, although the largish power brick weighs 1.7 pounds.

The drive reads many quarter-inch-cartridge (QIC)—standard tape formats, but it writes only to Iomega's proprietary 1-GB format (2 GB with compression). Fortunately, formatted Ditto 2GB cartridges have a street price below \$20—a lower cost per megabyte than comparable formats. If a tape becomes unusable for any reason, however, you'll have to

replace it. Iomega decided to prevent the Ditto 2GB from formatting tapes, citing the long format time and higher cartridge price.

Single-Step Backup

The Ditto Tools backup software (developed for Iomega by Arcada Software) is as easy to use as could be. You can back up a single file or an entire set of drive volumes in one session. The simple 1-Step version, the ultimate in auto-pilot, manages backup operations automatically and restores files just as easily. More experienced users craving backup flexibility can choose from various options, including full, incremental, and differential backups. Supported environments include DOS, OS/2, and Windows 3.x and 95. Iomega promises an NT version soon.

You'll appreciate the software's support for unattended backups, given the Ditto's somewhat sluggish performance. For example, on an 8-MB 486DX/66 system running Win 95 with default settings, Imeasured an average disk-to-tape speed of about 4.5 MB per minute with a typical mixture of applications and data. (Iomega claims speeds up to 9.5 MBps with faster systems.) Adding in the time required to verify the backup reduced the effective backup speed to 1.7 MBpm. At that rate, filling up an entire tape could take 10 hours.

RATINGS					
TECHNOLOGY	*	*	*	*	
IMPLEMENTATION	*	*	*	*	
PERFORMANCE	*	*	*		

The Ditto 2GB is not without problems—most of them common to all parallel-port tape drives. To function properly under DOS, for example, the drive needs exclusive use of a hardware interrupt. That means you have to resolve any potential conflicts with sound, net-



work, or other expansion cards manually. Drive performance is also highly dependent on system speed. On slower systems running Windows 95, don't expect to perform other tasks while backing up in the background. It's possible, but not practical.

A Personal Ditto

The Ditto 2GB drive combines a 1-GB native capacity (or 2 GB, assuming typical file compression) with ultraportability and affordable pricing—both for the drive and the media. And although its parallel-port interface means that it's not the fastest tape drive around, the Ditto is a solid choice for personal system backups.

Robert L. Hummel is an electrical engineer, programmer, and consultant. You can reach him on the Internet at rhummel@monad.net.

naos Vlanor

Don't Swap: Network!

Upgrading the Pournelle way means more than trading in one machine for another.

've got a new method for writing fiction, and it's been working so far. Every morning, including Saturday, I get up at 8:00, have a leisurely breakfast, and read the papers. By 10:00, I'm upstairs in what used to be Alex's room. There's nothing in it but an elderly (in this business, three years is old) Gateway 2000 486DX2, a steno chair, a portable ice chest I fill with Dr. Pepper and root beer, and Alex's old high school books. There are no distractions. No phone. No modem. No computer games. No interesting books.

I stay there until 12:30. So far, I have averaged more than 1000 words a day plus rewriting the previous day's output. *Starswarm*, my new juvenile about a boy who grows up with a computer in his head, is taking shape wonderfully, with over 50,000 words done. At more than a thousand words a day, it will be finished in two weeks.

The Gateway 2000 486DX2 was Roberta's computer before we upgraded her to a Gateway Pentium 200. It's a perfectly good machine, and we've never had any trouble with it. It's certainly fast enough for what I'm doing. (Heck, for writing fiction, a 286 with Q&A Write is good enough.) The programs I run are Windows 95 (Win 95), Microsoft Office, Norton Commander (for DOS), and Info Select.

Info Select is a general notes program. It started life as Tornado Notes, which was a far better name than Info Select. When Micro Logic changed it from a DOS pop-up to a Windows utility, they changed names. I find the name ugly, but it's a terrific utility.

I use Info Select to accumulate and organize notes, such as character names,

locations, and all the other stuff that goes into my novels. It's easy to copy some text, such as the first scene where I name and describe a character, switch to Info Select, create a note or open an existing one, and stuff the new information into it. It's also great for diaries, keeping track of work in progress, and other stuff. You can learn to use it in about 5 minutes, and I don't see how anyone gets along without it. Micro Logic also makes DiskMapper, a program that graphically maps your hard drive and shows you exactly what's eating up all that disk space. I'll try to get to that soon, too.

ently, CyberMedia caught the serial-number disease from Microsoft, because you can't install First Aid without one. This means keeping paperwork handy, and I don't want to do that, so I use a marking pen to write the serial number on the face (the printed side, not the data side) of the CD-ROM. I do that on all those that need a serial number. Now I can't lose the serial number.

The First Aid CD-ROM is auto-play, so when you put it in the drive, it offers to install the program for you. So far, so good, but now it asks for the serial number. I opened the CD-ROM tray to read

Heck, for writing fiction, a 286 with Q&A Write is good enough.

I've also installed CyberMedia's First Aid 95 Deluxe on this Gateway machine. I chose it as much for its cleanup capability as anything else. Roberta had a whole bunch of stuff on the computer that I don't need, so after I copied it all to her new machine, I erased almost everything. That freed up a lot of disk space, but it left a whole bunch of Win 95 shortcuts and other junk. First Aid seems to have fixed all that.

I had what I thought were some problems with First Aid on another machine, but I know now that the problems were something else. I've been using First Aid on a number of machines without difficulties. It's good for cleaning up after big deletes, and while I haven't needed the recovery features so far, I might.

On the other hand, the installation program sucks rocks.

Actually, that's not true; the installation program works fine once you get it going. The problem is the serial number. First Aid comes on a CD-ROM. Apparthe serial number. When I closed it, autoplay brought up another copy of the installation program. Eliminating that blew up the original installation program. There was nothing for it but to close down all attempts to install, copy the serial number on paper, and start over. Once that was done, things went smoothly enough, and First Aid's background programs came up on restart. I fail to understand the point of having serial numbers on CD-ROMs.

I formerly used Norton System Doctor to accomplish the same things that First Aid does, but System Doctor has an ugly feature: when it's running in the background, there's a steady blink-blink-blink of the cursor on the desktop that I find extremely annoying. First Aid does not do that.

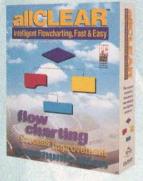
What I do on that upstairs machine is important. I back up to floppy disks every day, but I worry about power failures, so I have an American Power Conversion uninterruptible power supply (UPS) on

Instantly Document Corporate Policies, Procedures and Work Instructions

Have you ever drawn flowcharts for policies, procedures or process flows by hand...or with a PC drawing program?

If so, break your pencil in half ... and delete those antiquated drawing programs from your hard drive.

Introducing allCLEAR.



A better, faster, easier way to create all the flowcharts you need...integrate them into any written document...and rapidly revise them whenever your policies, procedures or processes change.



- · Flowcharts
- Network Diagrams TQM Diagrams
- Fishbone Diagrams Procedure Charts

It's fun, easy to use and it's guaranteed! So, stop wasting time and start churning out professional diagrams, like a pro, in minutes... even if you can't draw a straight line!



Call today to get your FREE report on how flowcharts can improve your processes.







http://www.clearsoft.com



the machine. If First Aid 95 Deluxe has even a small chance of saving the work in progress, it's worth it, and having it there makes me feel better.

here are still plenty of Windows 3.11 systems out there, so we need one here as a test-bed. The machine that got stuck with the job is SuperCow, a Gateway 2000 486DX2 VL-Bus system. When we got that machine, it was the fastest thing in the house. Over the years, this column has featured upgrades to SuperCow: a Western Digital Caviar AC31000 1-GB hard drive, a new BIOS to support that drive, more memory, and new video cards. One of the first upgrades was a Creative Labs Sound Blaster 16 card and a CD-ROM drive. That was at least three years ago.

Since then, I've used SuperCow for nearly everything, including using it as the world's heaviest portable: I used to lug it down to the beach house when I'd go there to write. Whether it was from doing that

That happened twice: the CD-ROM drive worked fine in DOS and locked up in Windows 3.1. Time to do some thinking. It took me longer than it should have to figure it out.

SuperCow is on my local Ethernet. When it comes up, it goes out on the network to connect to whatever machines it can find. Until that happens, though, the network card hasn't been accessed, and, more important, the interrupt request (IRQ) hasn't been used by the network card.

The Sound Blaster Performance 8× Kit comes set to use IRO 5 for the sound card. This is standard: many DOS games expect it to be there, and a few can't be set to look elsewhere. As a general proposition, you are best off leaving your sound card set to IRQ 5. (If you have a second parallel port, you'll have to choose a different IRQ for the sound card.)

The sound card uses a different IRQ for the eight-speed CD-ROM drive, and that

I've used SuperCow for nearly everything, including using it as the world's heaviest portable.

or something else, eventually the CD-ROM drive began to fail. It might have been the cable, or perhaps the laser needed cleaning-I'm not sure I ever cleaned it-but whatever happened, it stopped working. I decided this would be a good opportunity to update the double-speed CD-ROM drive, and as it happened, I had a new Creative Labs Sound Blaster Performance 8× Kit.

Physical installation was a bit tight. The CD-ROM cable Creative Labs supplied was shorter than the one that came with the original kit. However, because of the localbus slots, I didn't have any choice where to put the sound card/CD-ROM controller. Eventually, I had to shuffle the drives so that the CD-ROM drive was on top, with the floppy drives beneath it; hardly a big sacrifice-indeed, it's an improvementbut just a bit annoying because I was working in close quarters.

When I got it installed, I tested it all under DOS. The sound card worked fine. So did the CD-ROM drive. I went into Windows. As Windows came up, Mr. Spock gave me some information about the confines of this solar system, so the sound was working; but when I accessed the CD-ROM drive, the system locked tighter than a drum. The only way out was the power switch.

is set by default to IRQ 10. Once again, this is no bad thing. Many systems use IRO 10 for the CD-ROM drive, Unfortunately, that is where I long ago set the Intel EtherExpress card on the grounds that nothing uses IRQ 10 by default-which was true at the time. At least I'd found the cause of the problem.

I now had two choices: reset the Ether-Express card or the Sound Blaster. Resetting the EtherExpress card is simple, so in keeping with the notion that I go to a lot of trouble to try complex things so you don't have to. I decided to reset the Sound Blaster's CD-ROM drive IRO.

In theory, that should be simple. Like the EtherExpress card, there are no jumpers on the Sound Blaster. Instead, there is software that automatically configures the card, an attempt at Plug and Play. There's also software that is supposed to let you change the card's configuration. It's not well documented, so I called Creative Labs' technical-support department. The first two people I talked to couldn't make it work. The next day, I got calls from increasingly savvy people. It didn't help. We'd manage to get the card to reset to a different IRQ-but as soon as I powered down and brought it back up, it seized IRQ 10 with a death grip.

To make the story short, I finally gave

up. IRQ 10 belongs to the Sound Blaster to control the CD-ROM card. I used SoftSet to change the IRO for the EtherExpress card. That's a DOS program. One thing: if you change the IRQ for your network card in Windows 3.11, you must then invoke Windows with the command WIN /n, bringing it up without the network; go into the network settings; and manually change the IRQ to your new setting. If you don't, Windows will either lock up or try to change the card setting back to what it expects, and since Windows for Workgroups originally shipped with EtherExpress cards, Windows knows how to do that. The result is that you'll be back where you started. This is one case where attempts to Plug and Play actually get in

Now that the IRQ conflict is over, Super-Cow's CD-ROM, sound, and networking are fine. The CD-ROM drive is screamingly fast, the new speakers that came with the Creative Labs Sound Blaster Performance 8×Kit are wonderful, and all's right with the system. Of course, the processor is no faster than it was before, but like many of my readers, I get attached to my computers.

Note that if you install the Creative Labs Sound Blaster Performance 8×Kit on a system running Win 95, you shouldn't have any problems. The installation software was designed for Win 95 and understands it just fine. Do make sure you have the latest installation software from Creative Labs; they had some real teething problems with their early Win 95 installation, as did many others, and some of the old software is still in the dealer pipeline. The updates are on Creative Labs' BBS and Web site.

If you need sound-and most of us now do-and you want to add a CD-ROM drive to your system, the Creative Labs Sound Blaster Performance 8× Kit is a good way to go. The sound quality is more than good enough, you get a lot of neat software, and Sound Blaster is the standard that soundusing programs are written to. You won't have any trouble installing it in Win 95, and probably none in Windows 3.11 unless there's a conflict with your network card's IRQ. If there is, change the IRQ on the network card. Recommended.

You will have noted that we have several Gateway 2000 machines. There's RacingCow, a P5-133XL that Eric uses to cruise the Internet; SuperCow, and its non-VL-Bus counterpart I have upstairs; Joizy, my

PLATFORMS: WINDOWS NT • WINDOWS 95 • OS/2 • NLM

Q: What does it take to deploy a superior client/server application? A: A SUPERIOR SERVER

START with the most advanced client-side SDK on the market: c-tree® Plus at \$895.

- · Complete "C" Source code
- ROYALTY FREE (Client Side)
- · Multiple supported protocols
- · Fast, portable, reliable

BBOPEN . GNX

· LINUX · MOTOROLA

XIZO

• INTERACTIVE

BANYAN

- · Powerful features like transaction processing
- · Win95, NT, and Windows 3.1 ready

ADD a strong, multiplatform, industrial-strength Server that supports.

- · File mirroring
- · Heterogeneous networking
- · Automatic disaster recovery
- · Multi-threaded design
- · Best price/performance available: from \$445- \$3745

RESULT? A solid. economical, easily deployable product that fits vour needs.

DOS · APPLE

A/UX · LYNX

SCO

MANAGER

· SUN

SPARC-SOLARIS

回る

RS/6000

HP9000

RS/6000

- Portable
- Scalable
- · Exceptional Performance
- Flexible
- · Easy Server distribution
- Convenient OEM terms



Heterogeneous TCP/IP Network

You can't find a better client SDK with these features! Over sixteen years of proven reliability and performance. No one else supports over 30 platforms in this price range!

c-tree Plus®

- · Complete C Source
- · Single/Multi User
- Client/Server (optional)
- · Full ISAM functionality
- No Royalties
- · Transaction Processing
- · Fixed/Variable Length Records · High Speed Data/Index Caching
- Batch Operations
- · File Mirroring
- Multiple Contexts
- · Unsurpassed Portability

FairCom Server®

- · Client/Server Model
- · Transaction Processing
- · Requires <2MB RAM
- · Online Backup
- · Disaster Recovery
- · Rollback Forward
- Anti-Deadlock Resolution
- · Client-side "C" Source
- · Multi-threading
- · Heterogeneous networking
- · File Mirroring
- OEM/Source Available

FOR YOUR NEXT PROJECT CALL FAIRCOM: YOU CAN'T FIND A BETTER HETEROGENEOUS CLIENT/SERVER SOLUTION! Also inquire about these FairCom products: r-tree® ODBC Driver



WWWeb Address: http://www.faircom.com/ 800.234.8180

U.S.A. 4006 W. Broadway - Columbia, MO 65203-0100 phone (573) 445-6833 fax (573) 445-9698 EUROPE Via Patrioti, 6-24021 Albino (BG) - ITALY phone (035) 773-464 fax (035) 773-806

JAPAN IKEDA Bldg. #3,4f-112-5, Komei-chou - Tsu-city,MIE 514 Japan phone (0592) 29-7504 fax (0592) 24-9723

ATST Σ SYST Ш

Circle 144 on Inquiry Card.

SUN 0/S 4.X . SUN 0/S 5.X . MIPS ABI (SGI) .

wife's new P5-200XL; the Liberty laptop; and Alex sometimes uses the old Hand-Book. We work these machines hard; indeed, SuperCow has undergone some real torture tests, what with frequently being taken apart to accommodate new equipment and every couple of months being carried off to the beach house in the trunk of the car.

Except for an initial problem finding a free IRQ so we could add a SCSI board to RacingCow—that system came fully equipped with an internal modem and sound card, and my first act was to add an Ethernet card, using the last free IRQ—we haven't had any problems with these machines. Roberta used the older Gateway machine for years and now has the PS-200XL, which she loves.

These are not special machines. I get them off the factory line, just as you do, and, indeed, the P5-200XL came with evidence of hard shipping since a few of the bezels in the front panel had been displaced. It didn't seem to matter; the machine worked just fine right out of the box.

I say all this because I get a lot of mail

asking if it's really safe to buy computers by mail order, and I can only reply that it depends on the mail-order outfit. I know of several good ones, and I can't possibly tell you which is best. I can only say that I upgrade might keep that in mind. Example: we just acquired a Nimantics Orion 6×. It comes with a Pentium 150 processor, a built-in 6×CD-ROM drive, Sound Blaster, SVGA video in a 12.1-inch active-matrix

This is one case where attempts to Plug and Play actually get in the way.

can get just about any machine I want, and I've had quite satisfactory experiences with Gateway 2000 systems. I use them, and I rely on them.

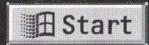
Note also that I write only about what I'm familiar with. There was a time when I might try to keep up with the field and know what's best, but that was long ago. Now, all I can guarantee is that I don't write about what I won't use, and I sure won't use anything that's not more than good enough.

f my mail is any indication, a lot of you are concerned about upgrade paths. I've given this a bit of thought.

First, there are now full-featured laptops that are good enough to be your only computer, and people looking to display, a 2.1-GB removable hard drive, and many other features. With 32 MB of RAM and the Pentium 150, Blue Streak—I've named it for the blue stripe on the packaging—is a real screamer.

The keyboard isn't bad, either: it's fullsize, with plenty of keys—it's not one of those "space-saving" designs that assigns two or even three functions to every other key—and it includes so-called Windows 95 keys. Of course, keyboards are a personal thing, but I like this one, and I can write with it.

I could write books with this machine, and, in fact, if I didn't already have the Gateway machine installed upstairs in Alex's old room, I'd probably be taking Blue Streak up with me. Be warned: by



At Microsoft, small products are the beginning of gigantic opportunities.

Microsoft's new, lightweight Windows® CE operating system is ushering in the next generation of inexpensive computing devices. Along with big new opportunities for forward-thinking innovative individuals.

Based on the familiar Windows32TM OS, the Windows® CE kernel is now being introduced in affordable, easy-to-use hand-held computers designed to exchange information with desktop PCs, read and send e-mail, and access the Internet.

But that's only the beginning. Imagine a global positioning system for automobiles, or Windows® CE-based consumer products. Windows® CE opens the door for an amazing variety of applications that will entertain, communicate, instruct and inform. And they're all up to you.

Hardware Program Manager

You'll lead the integration of new hardware technologies into the new Windows® CE operating system. This includes evaluating new hardware technologies, working with leading industry hardware companies, recommending important new technologies, and following through with Microsoft software developers to implement support. Qualifications? Minimum 2 years hardware design. Driver or embedded software development experience required. Excellent communication and interpersonal skills preferred. Knowledge of CPU design, PCMCIA, small displays, touch panels, infrared, or RF wireless desired. Travel is required.

E-mail your resume in ASCII text format (no attachments, please) to resume@microsoft.com (indicate Dept. A15h1-1196 in the subject header) or mail to: Microsoft Corporation, Attn. Recruiting A15h1-1196, One Microsoft Way, STE 303, Redmond, WA 98052-8303. No phone calls please. We are an equal opportunity employer and support workforce diversity.



There Is Only One Choice For Data Compression.

PKZIP for Windows



New Features in PKZIP for Windows Version 2.50

- Ability to create .ZIP files that span multiple diskettes
- Create a Windows self-extractor
- Self-extractor can span multiple diskettes
- ▶ Long file name support for Windows 95 (16 and 32-bit) and Windows NT (32-bit)
- Integration with Windows 95 & NT Explorer
- Plus additional features

The growth of the Internet and the increased use of World Wide Web browsers are creating a greater need to compressand uncompress data files. Saving disk space and saving on-line phone charges are big benefits of compressing data files with PKZIP® for Windows. PKZIP for Windows compresses files an average of 50-70% with many large text and database files compressing well over 90%. PKZIP's simple point-and-click interface lets you easily compress one file or all files on an entire hard drive, and store them in the .ZIP file. PKWARE provides the best and fastest data compression technology on the market, try it and see!

PKZIP for Windows allows you to easily open files created with PKZIP for DOS Version 2.04g. PKZIP is also compatible with Windows 3.1 or higher, Windows 95 and Windows NT.

PKZIP for Windows \$49, PKZIP for DOS \$47 plus shipping and handling.

To order call (414) 354-8699 or visit our Web Site http://www.pkware.com

See us at COMDEX Booth #\$2861

The Data Compression Experts® 9025 N. Deerwood Drive / Brown Deer, WI 53223 USA







1992-1996 PC World World Class Award

1996 Government Computer News Best New Product Award at FOSE Finalist

1995 Computer Currents Readers Choice Award 1993 Shareware Industry Award 1992 Premiere Computing Magazine Award 1992 Dvorak/Zoom Award

Other PKWARE Products

Put Your Executables on a Diet



PKLITETM increases your valuable disk space by compressing DOS and Windows 16-bit executable (.COM, .EXE and .DLL) files by an average of 45%. The operation of PKLITE is transparent, all you will notice is more available disk space! Price \$46

Software developers, save disk space and media costs with smaller executables. You can distribute your software in a compressed form with PKLITE Professional.™ PKLITE Professional gives you an extra option to compress files so that they cannot be expanded by PKLITE. This discourages reverse engineering of your programs. Price \$146

Put Compression Into YOUR Application

The PKWARE Data Compression Library® products allow you to incorporate data compression technology into your software applications. The application program controls all the input and output of data, allowing data to be compressed to or extracted from any device or area of memory.



The all-purpose Data Compression Algorithm compresses ASCII or binary data quickly. The routines can be used with most compatible language compilers. Separate DOS, DOS32 Windows, OS/2, Win32, **UNIX** and Macintosh versions are available! Call for pricing.













Don't Swap: Network!

today's standards, it's a real heavweight—about 8 pounds—if you're considering lugging it around airports, but on the other hand, it really is good enough to be your desktop machine. I don't have room here for as full a report as I'd like to give; but check the Pournelle bonus section on BYTE's Web site for much more on the Nimantics Orion 6×.

In my judgment, the best upgrade route is not to fiddle with your old system; get a new machine and network it to your old one. Ethernet boards are cheap and getting cheaper, and so are Ethernet PC Cards.

Win 95, and for that matter Windows 3.11, make networking simple and painless, and you'll soon find plenty to do with both systems. For one thing, you can do instant

need portability, you have other alternatives. The obvious one is to buy the fastest system you can find, a Pentium Pro, a Pentium 200, or one of the Cyrix wonders. Our

If you've decided to upgrade by networking, get the fastest new system you can afford.

backups of important work by sending a copy to the other machine. That practice has saved me more than once.

Full-featured laptops—like the Nimantics Orion 6×—are one way to upgrade your capabilities. However, if you don't

Cyrix 6x86-P166 system continues to work extremely well, and it's sure a fast machine.

Whatever you do, get a PCI-bus system and a PCI-bus Ethernet card for your new system; they're much easier to set up, and when Plug and Play works, it works very well.

On that subject, we've found there are two kinds of Ethernet cards to consider: 3Com and no-name generics. The nonames are cheap and often work, but if the drivers that come with them don't work well, you'll probably never get anything better. The 3Com cards come with good drivers, and when there are updates, you can download them. A PCI-bus 3Com Internet card will cost maybe \$30 more than a no-name card; in my judgment, the peace of mind and absence of installation problems are worth the money.

Understand, this is in the context of a low-cost upgrade by networking; those of you with more serious networking requirements should look into other alternatives, such as Applied Creative Technologies' Ultimate PCI-3000 network card. Of course, if you already have Ethernet cards that work, it's hardly worth buying new cards until you're ready for an upgrade to Fast Ethernet. We'll be doing that one of these days, but for the moment, I've found vanilla Ethernet plenty good enough.

Once you've decided to upgrade by networking, the obvious choice is to get the fastest new system you can afford. Less obvious—but possibly cheaper and better—is to get a reliable dual-Pentium system. If you go that route, you'll have to use Windows NT; Win 95 can't make use of your second processor, and given IBM's treatment of OS/2, I can't recommend that to anyone not already using it. That's a pity, but there it is. Fair warning: installation of NT isn't all that simple. If you don't know what you're doing, be prepared for headaches or get it preinstalled.

Once it's installed, you probably won't have any problems. We've been using NT 3.51 for a while, and it works well with a dual-processor system. Now there's NT 4.0, which is much like Win 95, so much so that most times you need to look to be sure



In an increasingly wired world, thousands of profitable smartcard applications are just waiting to be developed, in a wide variety of fields - banking, security, telecom, education, healthcare and more.

To seize this opportunity and create successful smartcard applications, all you need is **ASE**™—
The Aladdin Smartcard Environment.

ASE is an integrated, PC-based development environment that gives developers an efficient, flexible and secure tool for making the most of this exciting new technology.

The quickest, easiest, and most effective introduction to the world of smartcards is the ASE Developer's Kit. Each Kit is a comprehensive package containing everything you need to get acquainted with ASE.

The ASE Developer's Kit includes ASEDrive, a versatile smartcard drive; ASESoft interfaces and utilities; and various types of ASECards.

To gain access to the world of smartcards - order your low-cost ASE Developer's Kit today!

North America Int'l Office Germany United Kingdom Japan

847-808 0300, Fax: 847-808 0313, E-mail: ase.sales@us.aks.com +972-3-636 2222, Fax: +972-3-537 5796, E-mail: ase.sales@aks.com +49 89 89 42 21-37, Fax: +49 89 89 42 21-40, E-mail: info@fast-ag.de +44 1753-622266, Fax: +44 1753-622262, E-mail: sales@aldn.co.uk

Japan +81 426-60 7191, Fax: +81 426-60 7194, E-mail: sales@aladdin.oo.jp Call us for details of your local distributor! W W W . a k s . c o m

ALADDIN

KNOWLEDGE SYSTEMS LTD

1-800-562-2543

@ Aladdin Knowledge Systems Ltd. 1985-1996 (9.96) ASETM is a trademark of Aladdin Knowledge Systems Ltd. All other names are trademarks of their respective owners

Save the whales, the rain forests and the red berry cheesecake.



On the Web, you'll find some of the most quickly disappearing things on earth. Now, you can save these files easily by transferring them to a CD•R disc. And the easiest way to do this, is through WebGrabber. It installs directly onto your copy of Netscape Navigator™ 3.0 and works entirely within the Netscape Navigator browser. Plus, it lets you open and browse these saved files from within the browser and link back to the internet directly from your CD•R disc. So with WebGrabber, transferring Web files to a CD•R disc is extremely easy. Or, in other words, a piece of cake.

Available now with Netscape Navigator 3.0

Get the full story at www.elektroson.com



by Elektroson

you're not running Win 95. NT 4.0 is stable and, except for some DOS and Win 95 games, runs all your software.

If you are running multiple programs, especially if at least one is a DOS program, a dual 120 or 133 will likely be faster than one of the screamingly fast single-processor systems. You will almost certainly win with dual processors if you routinely run more than one DOS session simultaneously. DOS programs eat cycles, and handing control to a DOS program and then taking it back involves a deal of overhead. Dual processors let one run the application while the other does the overhead and housekeeping.

Actually, it's not quite that simple. The OS doesn't say "you do housekeeping and I'll do applications"; rather, the OS passes control back and forth as needed. Still, the effect is the same. The applications get the attention they need while the networking and other OS stuff goes on in the background.

A dual-processor system architecture will let you do all your networking and communications without losing speed.

We've been experimenting with Diamond Flower's dual-Pentium Doubleshot 133, and for many multiple tasks, it is by far the fastest machine in the house.

The original Pournelle's law was "one user, one CPU," but that was back when CPUs were really expensive. I've since amended it to "one user, at least one CPU." No one deep down inside likes to share CPU cycles with anyone-including oneself. I believe multiprocessor systems are the wave of the future. So, incidentally, does Intel. Of course, it's self-serving for Intel to recommend multiple processors, but that doesn't mean it's not a good way to go.

'm still tracking down the hesitations I get in Win 95. A dozen readers have made helpful suggestions; and I think I now know what the problem is.

The symptom is that every few minutes there's a series of hesitations, typically manifesting itself when I am typing: I strike the key, and nothing happens for half a second or so. This goes on for a couple of seconds and then the system returns to normal.

The strange part is that Pentafluge, a Pentium 60 that was the fastest thing in the house when we built it, didn't have this problem under Windows 3.11; but as soon as we changed over to Win 95, the hesitations began, and we see them in Win 95, Windows 3.11, and DOS programs.

We don't see these hesitations on all the machines; the common element among those that do have the problem is that they all have Intel EtherExpress-16 ISA Ethernet cards. I am told by a reader that all I need to do is get the updated Win 95 Ether-Express drivers, and my glitches will go

Idon't know if that's true. I downloaded what I thought were the proper Intel drivers. However, when I went to install them, Win 95 refused to believe there were any proper drivers in the directory I'd put them in. To make matters even worse, when I decided to reinstall the EtherExpress card with its original drivers, it took me five tries to get my network restored. The problem is that when Win 95 installs the EtherExpress hardware and default software, it does not automatically install NetBEUI. continued

MOVING?

please complete the form below and send it to:



BYTE Magazine Subscriber Services, PO Box 555, Hightstown NJ 08520

Fax: 609-426-7087

Phone (9 a.m. to 8 p.m., Eastern Time, Monday through Friday); 800-232-2983 (U.S.), or 609-426-7676

Current/Old Address:

New Address: Account Number Name Name Company Company Address Address City/State/Zip City/State/Zip Please allow up to 8 weeks for this change to become effective.

A Division of The McGraw-Hill Companies



With so many web sites popping up today, it's hard to know which ones Net the best results. Especially if you're an advertiser looking to reach key Information Technology prospects.

Fortunately, the answer is close at hand. It's called The BYTE Site, and more computing influencers worldwide call it "home" than just about any address on the Web.

The BYTE Site is the online version of BYTE magazine, the worldwide technical authority for computing experts. That means it's chockfull of insights and information about the IT market from products to applications to trends. On The BYTE Site, visitors can instantly access every BYTE article published since 1993 through the BYTE Archive. Read all about the newest products and technologies in our Virtual Press Room. Share viewpoints with BYTE editors worldwide by on-site Email. Even download industry standard CPU test suites from our BYTEMarks benchmark service.

With features like these, it's no wonder The BYTE Site logged nearly 150,000 visits this

past January alone, and posted an overall repeat visit rate of 41%. Not surprisingly, it's become equally popular among advertisers. That's because



The Byte Site offers such interactive marketing options as hot-linked AD-Action buttons to showcase product information, catalog listings and data sheets. Plus our Virtual Press Room where users can access the latest press releases from your company.

To learn more about The BYTE Site, call John Griffin, VP/Publisher at 603.924.2663. Or find him on The BYTE Site at http://www.byte.com. You'll discover reaching computing influencers worldwide is easy once you know where they live.



A Division of The McGraw-Hill Companies



You Can Do It Online!



Introducing Internet CONFERENCE



View, discuss, edit and approve documents with anyone in the world over the Internet.

Everyone can see the document you're working on. Internet Conference Professional Version 2 brings seamless and efficient real-time multimedia communication to your desktop. Use it to give remote presentations and receive instant feedback. Link several offices and your clients together. Telecommute. Work online using the same programs you use now; use your own spreadsheet, word processor, contact manager, graphics or CAD/CAM program. Create documents or make changes. Even draw and highlight. Everyone meets in the same place... Your PCI.

Make sales presentations remotely and interactively.



Turns your Microsoft® Office into an online application.

Work in Microsoft® Word, Excel or Powerpoint. Collaborate on projects.

Work on the Web together. Everyone views the same page at the same time.

Works on any network! Lan, Wan, Intranet, or Internet.

Download Free Trial

http://www.vocaltec.com/560.HTM

Call 800 - 899-3942

E-Mail: info@vocaltec.com



©1996 VocalTec Ltd. All rights reserved. VocalTec Inc., Internet Conference are all trademarks of VocalTec Ltd. Micrososoft Office, Word, Excel, Powerpoint are registered trademarks of Microsoft Corporation.

Don't Swap: Network!

NetBEUI is an elderly protocol whose major—almost only—use is Windows 3.11 and other Microsoft peer-to-peer networks, but you must have it for those.

Worse, the Network Troubleshooter wizard in the Win 95 Help system is almost useless. It does not ask if you have installed NetBEUI, so if you don't know you need that protocol, I don't know how you'd ever find out. I had forgotten I needed it, but since I had other systems networking properly, I could go study one that worked and see what I had left out.

In any event, I'm pretty sure the hesitations are caused by Intel EtherExpress cards running the Win 95 default drivers, and that they can be made to go away by either installing a different Ethernet card or getting the proper drivers for the Ether-Express card. I'll try to test that before we go to press next month.

The first book of the month is also the CD-ROM of the month: Erica Sadun's Java Script CD-CookBook (Charles River Media, ISBN 1-886801-35-5). This is a "book" you read with your Web browser. Clearly written, lots of examples, and probably the first of many "books" done this way.

A more traditional computer book of the month is Mark Warhol's *The Art of Programming with Visual Basic* (John Wiley and Sons, ISBN 0-471-12853-8). The subtitle is *Techniques for Writing Solid Code That's Easy to Maintain*, and it is all that and more. The chapter on naming conventions is worth the price of the book. If you do large Visual Basic programs, or you supervise people who do, this is nearly indispensable.

The book of the month is Thomas Cahill's How the Irish Saved Civilization: The Untold Story of Ireland's Heroic Role from the Fall of Rome to the Rise of Medieval Europe (Doubleday, ISBN 0-385-41848-5). It's as much a delightful insight into Irish character as a history. Parts of it are serious enough, but even then you'll hear an echo of Irish laughter.

The game of the month is The Pandora Directive from Access Software. This is one of those role-playing movie games, and frankly I wouldn't have fired it up if I hadn't noticed that my old neighbor John Agar is in it.

It's actually a rather interesting plot hinging around what happened in Roswell, New Mexico, on July 6, 1947, involving UFOs. The acting is quite good. I find the pace of this game to be a bit slow, but that's really saying that I am not usually fond of the kind of game where you must poke around, looking in desk drawers and under rugs, and talking to everyone in sight. For those who do like that kind of game, The Pandora Directive is about as good a one as I have seen.

The piles grow higher at Chaos Manor, and even with the longer column—see BYTE's Web site for the parts of the column that didn't get into the printed edition—I can't keep up. We now have CD makers, a lot of great new software, so many CD-ROMs I have lost count, and a whole bunch of stuff I wish I had space to tell you about. The computer revolution isn't slowing down at all.

Jerry Pournelle is a science fiction writer and BYTE's senior contributing editor. You can write to Jerry c/o BYTE, One Phoenix Mill Lane, Peterborough, NH 03458. Please include a selfaddressed, stamped envelope and put your address on the letter as well as on the envelope. Due to the high volume of letters, Jerry cannot guarantee a personal reply. You can also contact him on the Internet or BIX at jerryp@bix.com.

PRODUCT INFORMATION

First Aid 95 Deluxe about \$59.95 CyberMedia Santa Monica, CA (800) 721-7824 (310) 581-4700 fax: (310) 581-4736 http://www.cybermedia.com Circle 1006 on Inquiry Card.

Info Select \$149.95 Micro Logic Corp. Hackensack, NJ (800) 342-5930 (201) 342-6518 fax: (201) 342-0370 http://www.miclog.com Circle 1007 on Inquiry Card.

Orion 6× from \$2999 Nimantics, Inc. Tustin, CA (800) 646–5005 (714) 573–4030 fax: (714) 573–4025 http://www.nimantics.com/ Circle 1008 on Inquiry Card.

The Pandora Directive \$79.95 Access Software, Inc. Salt Lake City, UT (800) 800-4880 (801) 359-2900 fax: (801) 359-2968 http://www.accesssoftware.com Circle 1009 on Inquiry Card.

Sound Blaster Performance 8× Kit \$449 Creative Labs, Inc. Milpitas, CA (800) 998-5227 (408) 428-6600 fax: (408) 428-6611 http://www.creativelabs.com Circle 1010 on Inquiry Card.

BUTE

BUYER'S GUIDE

Essential Products and Services for Technology Experts

Mail Order

Top mail-order vendors offer the latest hardware and software products at the best prices. Page 196

Hardware/Software Showcase

Your full-color guide to in-demand hardware and software products, categorized for quick access. Page 219

Buyer's Mart

The BYTE classified directory of computer products and services, by subject so you can easily locate the right product. Page 228



TER DISCOUNT W

MICROTEK

ScanMaker E6

Capture lifelike color at a real-life price

600 x 1200 dpi optical, 4800 dpi interpolated resolution . Single-pass scanning ◆ 30-bit color ◆ 8 x 13 scan area ◆ Includes: Image Pals 2 Go, OmniPage LTD and ScanWizard

E6 Standard w/PhotoImpact

\$526.07 CDW 72263

695.10 CDW 65671 E6 Pro w/full Photoshop

ScanMaker E3

◆ 300 x 600 dpi optical resolution ◆ Single-pass scanning ◆ 24-bit color ◆ Includes PhotoImpact SE, Image Pals 2 Go, OmniPage LTD and ScanWizard

New lower price!

\$349.81 CDW 72264





Microsoft

Windows N7 Server V4.0

▲ One platform for e-mail, file server, databases and communica-

tions A Integrates seamlessly with existing systems, including NetWare* A Built-in Internet, Intranet and communications services A Includes web services: FrontPage and Internet Information Server

▲ Distributed on CD-ROM

\$738.93 CDW 73221 Server + 5-clients \$1023.57 CDW 73222 Server + 10-clients \$377.15 CDW 73214 Upg + 5 client licenses \$499.73 CDW 73218

Call your CDW Account Executive for Microsoft Windows NT Server V3.51 and other V4.0 configuations!

DISCOUNT PRICES HARDWARE SOFTWARE & PERIPHERALS AT

HAKDWAKE,	
SOFTWARE	
dobe PageMaker V6.0 WIN 3.5/CD	
dobe PageMaker V6.0 WIN upg 3.5/CD132.81	
dobe Photoshop V3.0.5 WIN 3.5/CD545.78	
dobe Photoshop V3.0.5 WIN 3.5/CD	
rcada Backup for Windows 9556,90	
Caere OmniForm V2.0 WIN95171.13	
Caere OmniPage Pro V7.0 WIN95 vers upg113.65	
Corel WordPerfect Suite V7.0 WIN95 CD241.34	
Corel WordPerfect Suite V7.0 WIN95 upg 3.5/CD133.70	
Corel WordPerfect Suite V7.0 WIN95 upg CD93.15	
2016 Word-Perfect Suite V/J. Wirrysb Upg CD 39,18 2017 Word-Perfect Suite WIN 3.5/CD 274,38 2017 Word-Perfect Suite WIN CD 241,34 2017 Word-Perfect Suite WIN upg 3.5/CD 33,70 2017 Word-Perfect Suite WIN upg CD 91,77 2018 Word-Perfect Suite WIN upg CD 91,77 2018 2018 2018 2018 2018 2018 2018 2018 2018 2018 2018 2018 2018 2018 2018 2018 2018 2018 2018 2018 2018 2018 2018 2018 2018 2018 2018 2018 2018 2018 2018 2018 2018 2018 2018 20	
Corel WordPerfect Suite WIN CD	
orei WordPerfect Suite Will upg 3.5/CD135.79	
Corel WordPeriect Suite Wiln upg CD	
Dereu Wicker Winder Wi	
Astronom Processor Plus V3 0 WINDS WIN CD. 101 EE	
Joleina WinEAY PRO V7 0 WINGS 77 35	
Delrina WinFAX PRO V7.0 WIN95 CD 78.84	
Helix Hurricane V2.0 WIN95/WIN	
ntuit QuickBooks V4.0 WIN95.70	
ntuit Quicken Deluxe V5.0 WIN CD59.99	
otus 1-2-3 V5.0 WIN291.45	
otus 1-2-3 V5.0 WIN spec upg	
ohus SmartSuita 96 WINDS upg CD 116 79	
McAfee VirusScan V2.0 WIN9544,23	
AcAfee VirusScari V2.2 WIN44,17	
Microcom Carbon Copy V6.1 DOS88.61	
AcAfee VirusScan V2.2 WIN95. 44.25 AcAfee VirusScan V2.2 WIN 44.17 AcAfee VirusScan V2.2 WIN 44.17 Addicrocom Carbon Copy V6.1 DOS 88.61 Addicrocom Carbon Copy V6.1 DOS 88.61	
Microsoft Encarta '96 World Atlas WIN95 CD44,94	
Microsoft Encarta Encyclopedia 1996 WIN CD 44.94 Microsoft Excel V5.0 WIN comp upg 114.98 Microsoft FrontPage V1.1 WIN95 137.34	
Aicrosoft Excel V5.0 WIN comp upg114.98	
Aicrosoft FrontPage V1.1 WIN95187.34	
Alcrosoft MS-DOS V6.22 upg51.52	
Aicrosoft MS-DOS V6.22 upg	
dicrosoft Office Professional V4.3 WIN upg	
MS Office Professional w/Access WIN95 upg314.50	
MS Office Professional WIN95 CD w/Bkshelf539.03	
MS Office Professional WIN95 upg CD w/Bkshelf314.29	
Aicrosoft Office Std WIN95 CD461.57	
Microsoft Office Std WIN95 upg223.97	
dicrosoft Office Std WIN95 upg CD229.31	
Aicrosoft Office V4.2 WIN	
Microson Office v4.2 WIN upg	
Microsoft Plus! WIN9544.84	
Microsoft Plusi WIN95 CD45.13	
flicrosoft Project V4.0 WIN416.73	
flicrosoft Publisher CD Deluxe WIN9569.29	
ficrosoft Publisher V2.0 WIN	
MS Visual Basic Pro V4.0 WIN95/WIN/NT CD443.49	
AS Visual Basic Pro V4.0 WIN95WIN/NT vers upg CD .86,33 dicrosoft Visual C++ Subscription WIN95447,93	
dicrosoft Windows 95	
dicrosoft Windows 95 upg	
Aigment Windows 95 upg CD 94.77	
flicrosoft Windows 95 upg CD 94.77 flicrosoft Windows V3.11 92.06	
Microsoft Word V6.0 WIN upg 114.98 Microsoft Word V7.0 WIN95 upg 55.35	
Alcrosoft Word V7.0 WIN95 upg55.35	
Alcrosoft Works V3.0 WIN45.13	
Alcrosoft Works WIN9545.13	
letManage ECCO Pro V3 0 WIN 88 88	
Quark QuarkXPress V3.32 WIN574,86	
Quark QuarkXPress V3.32 WIN	
Duarterdeck OFMM VR 0 WIN95/WIN 62.16	
Symantec ACT! V2.0 WIN171.24	
Symantec ACTI V2.0 WIN	
symantec Norton AntiVirus V3.0 DOS/WIN49.20	
vmantec Norton Antivirus vvilvis	
symantec Norton AntiVirus WIN95 trade-up	
ymantec Norton NT 100IS V1.0 WIN NT CD45.00	
ymantec Norton Utilities V8.0 DOSWIN 112.53 bymantec Norton Utilities WIN95 116.15 bymantec Norton Utilities WIN95 trade-up 57.24	
rymaniec Norton Utilities WINGS trade up 27.04	
ymantec pcANYWHERE V2.0 WIN119.21	
symantec pown twinerie vz.0 wilk	
omantec pcANYWHERE V7.5 WINGSAIT upg 84.76	
omentes noANYWHERE32 V7 5 WINDENIT 474 BA	
Amantec WinFAX PRO V4 0 WIN 75 44	
tymaniece pokin Ywinerie V.3.5 WiN95/NT upg. 81.79 tymaniec pokinYWHERE V.7.5 WiN95/NT upg. 81.79 tymaniec pokinYWHERE32 V.7.5 WiN95/NT	
isio Technical V4.1 WIN95/WIN/NT 259.78	
1-1-1/4 0 MINI 0 C/OD ATO 40	

NETWORK NO. CO. CO.	
NETWORKING PRODUCTS	
Novell	
5-user CDNetWare 4.1	.715.60
10-user CD.	1619.15 2391.71
10-user CD. 25-user CD. 50-user CD.	2391.71 3231.25
100-user CD	4509.48
NetWare 3.12 5-user 3.5*	699.03
10-user 3.5" 25-user 3.5" 50-user 3.5"	1574,17 2325,28 3231,25
50-user 3.5"	1231.25
100-user 3.5"	4509.48
	471.75
Single-user license	93.91 487.29
Multilingual client/admin CD Single-user license 5-user CD 25-user CD ManageWise V2.0	2337.53
10-user CD	875.62
10-user CD	1852.58
	TO ARIHE
Single-user CD	.169,52 1344,42
10-user CD	4678.57
Microsoft	
Version upg CD	.686.74
Version upg CD. Comp upg CD.	1591.06
Full version CD	1958.91 1159.88
20-client license	3697.84
Windows NT Server V3.51 Server CD	622.50
Network Value Pack w/Internet Info Server	.889.15
20-client license pack	.37.86 .503.27
Windows NT Server V4.0	
Upg + 5-client license CD	.377,15 .499,73
Comp upg + 5-client license CD	376.92
Upg + 10-client license CD Comp upg + 5-clent license CD. Comp upg + 5-clent license CD. Comp upg + 10-client license CD. Server + 5-client license CD. Server + 10-client license CD. Server + 10-client license CD.	503.25 738.94
Server + 10-client license CD	1023.61
Single-client license	34.08
	133,53
Version upg CD. Single-client upg Full version CD.	239.49
	283.20
Server + 5-client license CD	1237.62
Server + 10-client license CD	1761.65 3516.50
5-client license	659.16 2084.28
Microsoft Systems Mamt Server V1.	
SMS Server CD	579,18 583,18 48,14
Single-client license	48.14
20-client license	716.04
SNA Server CD	359.59
Single-client license	.55.37 .861.40
Microsoft Exchange Server V4 0	
Server + 5-client license CD. Server + 10-client license CD. Server + 25-client license CD.	889.76 1218.21 1905.20
Server + 25-client license CD	1905.20
3Gon	
3C900 Etherlink XI PCI 10BT	112.16
3C900 EtherLink XL PCI 10BT 5-pack	.504.30
3C900 Ethernet XL PCI combo	.132.85
3C905 Fast EtherLink XL PCI 10/100BT	136,95
SuperStack II Hub 12-port 10BT	.506.93
SuperStack II Hub 24-port 108T	.866.77
SuperStack II Hub 48-port 100BT	5974.26
SuperStack II Switch 1000 12-port Enet	2489.74
SuperStack II Hub TR 12-port	1192.51
3C900 EtherLink XL PCI 108T 5-pack 3C900 EtherLink XL PCI 108T 5-pack 3C900 Ethermet XL PCI 00005 3C900 Stast EtherLink XL PCI 101/008T 3C905 Fast XL Hub 12-port 108T 3C905 SuperStack II Hub 12-port 1008T 3C905 SuperStack II Switch 1000 12-port Enet 3C905 SuperStack II Switch 1000 24-port Enet 3C905 SuperStack II Hub TR 12-port 3C905 SuperStack II Hub TR 12-port 3C905 SuperStack II Switch 2000 TR 12-port	3549.47
Artisujt	
LANtastic V7.0 Starter kit 3.5" + CD.	245.54
Starter kit 3.5" + CD. Add-on kit 3.5" + CD. 1-user comp upg CD.	128.55
10-user comp upg CD	232.51
ModemShare V7.0 1 shared port, unlimited users	87.91

NETWORKING PRODUCTS
COMPAQ.
Neteiligent 10BT PCI controller
EtherExpress PRO/10+ PCI combo
ULINKSYS.
Combo Ether16 LAN card
SMC'
EtherEZ 5T 108T hub. 88.00 EtherEZ 8T 108T hub. 151.97 EtherEZ 16T 0 108T hub. 344.12 EtherEZ 108T lab. 92.03 EtherEZ 108T ISA. 92.03 EtherEZ 108T ISA. 572.05 EtherPower 108T PCI 117.03 EtherPower 108T PCI 139.36 TigerSlack 108T 12-port hub. 498.02 TigerSlack 108T 26-port hub. 858.25
DATA STORAGE
COLOURADO
Jumbo 350 350MB TBU internal 59,70 Jumbo 1400 1,3GB TBU internal 990,00 Trakker 350MB TBU parallel 147,00 T1000E 800MB TBU parallel 181,93
iomega
Zip drive 100MB parallel 199.00 Zip drive 100MB SCS 199.00 Zip drive 100MB SCS 199.00 Ditto Easy 800MB Travan internal 119.00 Ditto Easy 800MB Travan external 349.00 Jaz drive 16B Internal SCSI-2 399.00 Jaz drive 1GB external SCSI-2 499.00 Jaz drive 1GB cartridge 124.00 Jaz drive 1GB cartridge
SONY
SDT-5200 DDS-2 DAT internal 976.90 SDT-5200 DDS-2 DAT external 788.58 SDT-5000 DDS-2 DAT internal 843.63 SDT-5000 DDS-2 DAT external 1006.73 SDT-5000 DDS-2 DAT external 1006.73 SDT-7000 DDS-2 DAT internal 927.77
9
AND THE COLO
MULTIMEDIA
ADS TV Superscan 2 PC to TV converter
TIES STEAM OF THE TRANSPORT

	INPUT DEVICES	
Alps Des	ktop GlidePoint	61.5
Alps Glid	ePoint Windows 95 keyboard	87.19
Calcomp	Drawing Slate II 6x9 w/pressure pe	n179.94
Calcomp	Drawing Slate II 12x12 w/pressure	pen 199.98
Epson Pl	notoPC digital camera	499.00
Epson Ad	tionScanning System II	403.2
Epson E	S1000C color scanner	539.80
Epson El	S1200C Pro color scanner	1134.0
Hewlett F	Packard ScanJet 4s	184.2
	ackard ScanJet 4p	
Hewlett F	ackard ScanJet 4c	894.01
Kodak Di	C20 Digital Science Camera	329.00
Kodak Di	C40 Digital Science Camera	599.01
	C50 Digital Science Camera	
Logitech	MouseMan 96	49.1
Logitech	Cordiess MouseMan	67.4
Logitech	TrackMan Marble	75.5
Logitech	TrackMan Live! cordless pointer	109.44
Logitech	PageScan color scanner	297.7
Microtek	PageWiz compact scanner	114.6
Microtek	ScanMaker E3 color flatbed	349.8
Play Sna	ppy video still capture	165.9
Umax Vis	sta-S6E SOHO scanner	568.0
Umax Vis	sta-S-12 scanner	796.8
visionee	PaperPort Vx scanner	257.41
visionee	PaperPort ix scanner	297.29
	MONITORS	

Mag Innovision DX1595 PnP 15 - 28mm 358.58 Mag Innovision DX1795 PnP 17 - 28mm 512.81 Mag Innovision DX175 T 15" - 28mm 394.96 Mag Innovision DX175 T 17" - 28mm 194.81 Mag Innovision MXP1F 17" - 28mm 1144.25 Mag Innovision MXP1F 21" - 28mm 1444.25 Magnavox CM0099 14" - 28mm 244.28 Magnavox CM0099 14" - 28mm 342.68 Magnavox CM016 15" - 28mm 342.68 Magnavox CM016 18" - 28mm 389.30 NEC 400 14" - 28mm 328.15 NEC 400 14" - 28mm 389.30 NEC 500 15" - 25mm 478.81 NEC 500 15" - 25mm 478.81 NEC 500 15" - 25mm 179.88 NEC 500 15" - 25mm 179.88 NEC 500 15" - 25mm 171.15 NEC 5	MONITORS	
Sory Mulliscan 15sfl 15* PRP 25mm	Mag Innovision DX1595 PnP 15". 28mm 369.58 Mag Innovision DX1795 PnP 17". 28mm 812.51 Mag Innovision DX171 St 28mm 812.61 Mag Innovision DX171 T1". 28mm 394.49 Mag Innovision DX171 T1". 28mm 384.81 Mag Innovision DX171 T1". 28mm 144.22 Mag Innovision MX21F 21". 28mm 344.82 Magnavox CM2098 14". 28mm 342.50 Magnavox CM0018 17". 28mm 342.50 Magnavox CM018 17". 28mm 399.50 Magnavox CM0418 17". 28mm 380.75 NEC CW12+ 15". 28mm 380.75 NEC CW12+ 17". 28mm 371.13 NEC XV12+ 17". 28mm 1711.15 Samsung 17GL 17". 28mm 789.50 Samsung 17GL 17". 28mm 789.50 Sony Mulliscan 15st 15". PPP. 25mm 396.50 Sony Mulliscan 25st 15". PPP. 25mm 396.80 Sony Mulliscan 25st 15". 27mm 386.50 Sony Mulliscan 25st 15". 27mm 385.65 Sony Mulliscan 15st 15". 27mm 385.65 Sony Mulliscan 15st 15". 27mm 385.65 Millson 15st 15". 27mm 385.65	
	VIDEO BOARDS	

VIDEO BOARDS	
TI 3D Xpression PCI 2MB TI Graphics Xpression PCI 2MB TI Graphics Xpression ISA 2MB	94.71
TI Graphics Pro Turbo PCI 2MB TI Graphics Pro Turbo PCI 4MB TI Video Xpression PCI 2MB	315.66
iamond Stealth64 2120 PCI 1MB	223.72
atrox Millennium PCI 2MB WRAM	377.00

OVERDRIVE PROCESSOR Int I

IIIIGI	
verDrive DX4/75	138,66
verDrive DX4/100	178.74
rerDrive Pentium 63MHz	158.06
verDrive Pentium 83MHz	
arDrive Pentium 120/133MHz upg for 5/60,	5/66 253.45
verDrive Pentium 125MHz upg for 5/7	5263.45

Intel OverDrive DX4/100178.74
Intel OverDrive Pentium 63MHz158.66
Intel OverDrive Pentium 83MHz189,27
Intel OverDrive Pentium 120/133MHz upg for 5/60, 5/66 253,45
Intel OverDrive Pentium 125MHz upg for 5/75263.45
Intel OverDrive Pentium 150MHz upg for 5/90319.20
Intel OverDrive Pentium 166MHz upg for 5/100456.23
PC CARDS
3Com Etherlink IIIC

3Com Etherlink IIIC. 3Com Etherlink III 28.8 Enet 10BT. Megahertz 10BT Enet adapter wXXACK. Megahertz 28.8 V.34 datafraw XXACK. Megahertz 28.8 V.34 datafraw XXACK. Megahertz 28.8 V.34 cellular wXXACK. Megahertz 28.8 V.34 cellular xXACK. Megahertz 28.8 Cellular xXACK. Megahertz 28.8 Cellular xXACK. Simple 28.8 Communicator cellular. Simple 28.8 Communicator



io V4.0 WIN 3.5/CD

NASDAQ

BUY WITH CONFIDENCE CDW® IS A NASDAQ TRADED COMPANY TICKER SYMBOL CDWC D & B rated 5A1 Duns 10-762-7952



shared port, unlin shared ports, unli







CDW® TELEPHONE HOURS Sales Monday-Friday 7am-9pm CST

NEC 5k6 6X CD external ...
NEC 5k7 8X CD internal IDE ...
NEC 5k1 8X CD internal SCSI-2 ...
NEC 5k6 8X CD external SCSI-2 ...
NEC 5k6 8X CD external SCSI-2 ...
Panasonic portable 4X CD SCSI ...
Sony portable 4X CD Discranal® ...
SunMoonStar 6X CD portable ...
SunMoonStar 6X CD internal IDE/ATAPI ...
SunMoonStar 6X CD portable ...

Saturday 9am-5pm CST Tech Support for Customers Monday-Friday 8am-9pm CST Saturday 9am-5pm CST If you find a better price, call CDW® before you buy 847-465-6800 Fax: Sales: 800-959-4239 (4CDW)

153.71 341.76 449.51 .399,00 .347,46 .259.37 .161.12 .271.88

Snappy

The best way to get pictures into your PC

Grab sensational PC stills from any camcorder, VCR or TV. Just plug Play's Snappy into your PC's printer port, then connect to any video source with the included cable. With the press of a button, Snappy captures images in 16.8 million colors at resolutions up to 1500 x 1125. From desktop publishing to creating PC photo albums, Snappy makes your PC more powerful, more visual and more fun!

\$181.97 CDW 74744



CDW **SERVICES YOU** BETTER"

J Series



♦ Intel® Pentium® processor ♦ 8MB RAM, upgradeable to

40MB ♦ Hard drive upgradeable to 1.35GB • Integrated 14.4K bps data/fax modem (J10, J30, J50)

♦ 5.8lbs

CPU	Hard Drive	Display	Price	CDW
75MHz	500MB	10.4" dual-scan	\$1958.56	64481
100MHz	540MB	11.3" dual-scan	\$1736.97	73027
100MHz	800MB	10.4" active-matrix	\$2434.62	64483
133MHz	800MB	10.4" active-matrix	\$2808.50	67377
	75MHz 100MHz 100MHz	75MHz 500MB 100MHz 540MB 100MHz 800MB	CPU Drive Display 75MHz 500MB 10.4" dual-scan 100MHz 540MB 11.3" dual-scan 100MHz 800MB 10.4" active-matrix	CPU Drive Display Price

CDW® CARRIES OVER 20,000 PRODUCTS. IF YOU DON'T SEE IT, CALL!

O MITOTERS	
TOSHIBA	Title Col
Satellite & Satellite Pro Noteb	ooks
110CS 5/100 8MB 810MB 11.3* dual	1939.75
110CT 5/100 8MB 810MB 11.3" active	2469.07
410CS 5/90 8MB 772MB 11.3" dual	2274.62
410CDT 5/90 8MB 772MB 11.3" active 4X	CD 2739.39
420CDS 5/100 8MB 810MB 11.3" dual 6X (CD. 2505.75
420CDT 5/100 8MB 1.26GB 11.3" active 6)	CD3289.82
Portege Notebooks	
610CT 5/90 8MB 720MB 9.5* active	2429.66
620CT 5/100 8MB 1.2GB 10.4° active	
650CT 5/133 16MB 1,26GB 11.3* active	4339.19
Tecra Notebooks	
500CS 5/120 16MB 1.26GB 12.1" dual	3657.56
500CDT 5/120 16MB 1.26GB 12.1* active 6X C	D4519.30
720CDT 5/133 16MB 1.13GB 12.1" active 6X	CD,5289.11
730CDT 5/150 16MB 2GB 12.1" active 6X	CD 8002.37
ACT	

A51.	
Ascentia Notebooks	
J10 5/75 8MB 500MB 10.4* dual	1979.47
J20 5/100 8MB 540MB 11.3" dual	1736.97
J30 5/100 8MB 800MB 10.4" dual	2063.79
J30 5/100 8MB 800MB 10.4* active	2434.62
J50 5/133 8MB 800MB 10.4* active	2808.50
P30 5/100 8MB 800MB 11.3* dual 4X CD	2408.28
P30 5/100 8MB 1.2GB 11.3* dual 4X CD	2596.09
P40 5/120 16MB 1GB 11.3' active 6X CD	3287.93
P40 5/120 16MB 2.1GB 11.3* active 6X CD	3749.59
P50 5/133 8MB 800MB 11.3* active 4X CD	3528.11
P50 5/133 8MB 1,2GB 11.3" active 4X CD	3809.67

P50 5/133 24MB 1GB 12.1* active 6X CD	4217.73
P50 5/133 24MB 2.1GB 12.1" active 6X CD.	4676.95
Advantage! Lifestyle Mini-towe	ers
9312 5/166 24MB 2.5GB 8X CD	2445.84
9310 5/166 24MB 2.5GB 8X CD	2351.94
9315 5/166 32MB 2.5GB 8X CD	
9316 5/200 32MB 3GB 8X CD	
Advantage! 9300 Series Mini-tov	
9304 5/133 24MB 1.6GB 8X CD	1659.53
9308 5/166 24MB 2.5GB 8X CD	
9314 5/200 24MB 4GB 8X CD	
Denue Decktoon	
bravo Desktops	4400 40

9314 5/200 24MB 4GB 8X CD	2655.64
Bravo Desktops	
LC 5100 5/100 8MB 630MB	1167.46
LC 5100 5/100 16MB 1.2GB	1287.19
LC 5133 5/133 8MB 630MB	1293.52
LC 5133 5/133 16MB 1.2GB	1375.74
LC 5166 5/166 16MB 1.2GB	1704.60
MS 5100 5/100 16MB 1.2GB	1377.41
MS 5100 5/100 16MB 2.1GB	1488.05
MS 5133 5/133 16MB 1.2GB	1499.11
MS 5133 5/133 16MB 2.1GB	
MS 5166 5/166 16MB 2.1GB 6X CD	2052.28
Bravo Mini-towers	
MS-T 5100 5/100 16MB 1.2G8	1399,54
MC T F100 FH00 10MP 0 10D	SEAT TO

COMPAQ Armada Notebooks 1120 5/100 8MB 810MB 10.4* dual......

1120T 5/100 8MB 810MB 10.4" active	
4110 5/100 8MB 810MB 11.3* dual	2496.17
4110D 5/100 8MB 810MB 11.3* dual	2879.37
4120 5/120 16MB 1.08GB 11.3* dual	3072.47
4120T 5/120 16MB 1.08GB 11.8' active	3744.82
4130T 5/133 16MB 1.08GB 11.8" active	4417.17
LTE 5000 Series Notebooks	
5000 5/75 8MB 810MB 10.4" active	3848,77
5100 5/90 8MB 810MB 10.4" active	4032.97
5100 5/90 8MB 810MB 10.4" active 2X CD	4417.17
5150 5/100 8MB 810MB 11.3' dual	2879.37
5200 5/120 8MB 1.35GB 10.4° active	4801.37
5250 5/120 16MB 810MB 10.4* active	
5280 5/120 16MB 1.35GB 11.3" active	
5300 5/133 16MB 1,35GB 12.1* active	
5380 5/133 16MB 2.16GB 12.1* active	5761.87
Deskpro 2000 Series Desktop	ps
5100/630 5/100 8MB 630MB	
5100/1200 5/100 8MB 1.2GB	1282.55
5100/1200 5/100 16MB 1.2GB	1384.25
5120/1200 5/120 8MB 1.2GB	
5120/1200 5/120 16MB 1.2GB	1502.90
5133/1200 5/133 16MB 1.2GB	
5133/2500 5/133 16MB 2.5GB	1858.85
5166/1200 5/166 16MB 1.2GB	
5166/2500 5/166 16MB 2.5GB	
5200/2500 5/200 32MB 2.5GB	
6180/1200/CD 6/180 16MB 1.2GB 8X CD	
6200/2500/CD 6/200 16MB 2.5GB 8X CD	3152.70

COMPAQ.	
Deskpro 2000 Series Mini-towers	
5133/2500/CD 5/133 16MB 2.5GB 8X CD	2073.
5166/2500/CD 5/166 32MB 2.5GB 8X CD	2621.
6200/2500/CD 6/200 32MB 2.5GB 8X CD	3406.5
Deskpro 4000 Series Desktops	
5120/1080 5/120 16MB 1.08GB	1627.
5120/1620/LS 5/120 16MB 1.62GB	1875.
5133/1080 5/133 16MB 1.08GB	1808.
5133/1620 5/133 16MB 1.62GB	1875,
5166/1620 5/166 16MB 1.62GB	
5166/2500/LS 5/166 16MB 2.5GB	2508.
6180/1620/CDS 6/180 32MB 1.62GB 8X CD	3051.
6200/2500/LS/CDS 6/200 32MB 2.5GB 8X CD	3638.
Deskpro 4000 Series Mini-towers	
5133/1620/LS 5/133 32MB 1.62GB	2309.1
5166/2500/CDS 5/166 32MB 2.5GB 8X CD	2881.
Deskpro 6000 Series Desktops	
5166/1080/CDS 5/166 16MB 1.08GB 8X CD	2847.
5166/1080/CDS 5/166 32MB 1.08GB 8X CD	3107.
ESON HORSE COME SOME 4 NOOD BY CD.	3510 (

6180/2150/CDS 6/180 32MB 2.15GB 8X CD	3813.7
6200/2150/CDS 6/200 32MB 2.15GB 8X CD	
6200/4200/PDS 6/200 32MB 4.2GB PD-CD	4847.79
Deskpro 6000 Series Mini-towers	
5166/2150/CDS 5/166 32MB 2.15GB 8X CD	3519.9
6200/4200/PDS 6/200 32MB 4.2GB PD-CD	4881.66
Presario Desktops	
4112 5/120 16MB 1.6GB 6X CD	1499.00
4122 5/150 16MB 2.5GB 8X CD	1899.00
4402 5/133 16MB 1.6GB 6X CD built-in 15* monitor	1989.00

4122 5/150 16MB 2.5GB 8X CD 4402 5/133 16MB 1.6GB 6X CD built-	
Presario Mini-t	
4704 5/133 16MB 1.6GB 6X CD	1699.00
4712 5/166 24MB 2.5GB 6X CD	2199.00
6704 5/166 24MB 2.5GB 8X CD	2399.00
8702 5/166 24MB 2.5GB 8X CD	
4716 5/200 32MB 2.5GB 8X CD	
6708 5/200 32MB 2.5GB 8X CD	
WW. 10. 10	
TRM	

365ED 5/100 8MB 540MB 10.4" dual 4X CD	1969
365ED 5/100 16MB 810MB 10.4" active 4X CD	2537
365X 5/100 8MB 810MB 10.4* dual	1989.
365X 5/100 8MB 810MB 10.4* active	2339.
365XD 5/100 8MB 810MB 10.4* dual 4X CD	2365
365XD 5/120 8MB 1GB 11.3" dual 4X CD	2582
365XD 5/120 8MB 1GB 10.4* active 4X CD	2887.
560 5/100 8MB 810MB 11.3* dual	2761.
560 5/120 8MB 810MB 12.1* active	3743.
560 5/133 BMB 1GB 12.1" active	4195
760E 5/120 8MB 810MB 12.1* active	4407
760E 5/120 8MB 1.2GB 12.1° active	4427
760E 5/133 16MB 1.08GB 12.1" active	5947
760ED 5/133 16MB 1.2GB 12.1" active 4X CD.	
760EL 5/100 8MB 810MB 11.3" dual	
760ELD 5/100 8MB 810MB 12.1" active 4X CD	
760EL 5/120 8MB 810MB 11.3" dual	
760FL 5/120 8MR 1 08GR 12.1" active	4392

/60EL 5/120 8MB 1.08GB 12.1" active	9-092.
760EL 5/133 16MB 1.08GB 12.1° active	5497.3
Aptiva Series Desktops	
C33 5/133 16MB 1.6GB 8X CD	1999,0
C65 5/166 16MB 2GB 8X CD	2449.0
C73 5/200 16MB 2.5GB 8X CD	
PC300 Series Desktops	
PC330 5/133 16MB 1.2GB 3 bays	1739.5
PC330 5/133 16MB 1.6GB 3 bays	1808.
PC340 5/100 16MB 1.2GB 4 bays	
PC340 5/133 16MB 1.2GB 4 bays	
PC350 5/100 16MB 1.2GB 5 bays	
PC350 5/133 16MB 1.2GB 5 bays	
PC350 5/133 16MB 1.6GB 5 bays 6X CD	1998.
PC350 5/166 16MB 1.6GB 5 bays	
DC700 Corine Desistana	

NEC

2400 5/100 8MB 810MB 11.3* dual	2299.	00
2400CD 5/100 16MB 1GB 11.3* dual 6X CD	2699.	.00
4200 5/100 8MB 810MB 10.4* active	2999	.00
4230 5/133 8MB 1.08GB 10.4* active 6X CD	3899.	00
4050H 5/90 8MB 810MB 10.4" active		
4080H 5/120 8MB 1GB 10.4" active	3699	.00
6000H 5/100 16MB 1.08GB 11.3" active 6X CD	3999.	00
6030H 5/133 16MB 1.35GB 12.1" active 6X CD	4999	00
6030X 5/133 16MB 1.44GB 12.1" active 6X CD	5399.	.00

INSTRUMENTS	
Extensa Notebooks	
510 5/100 8MB 810MB 10.4" dual	1739,77
555CD 5/75 8MB 524MB 10.4" dual	1354,90
570CD 5/100 8MB 810MB 11.3* dual 6X CD	2248.27
570CDT 5/100 8MB 1.2GB 10.4" active 6X CD	2894.07
TravelMate Notebooks	
TM5200 5/120 8MB 1.2GB 11.3* active	2791.43
TM5300 5/133 8MB 1.2GB 11.3* active	2701.43
TM6020 5/120 8MB 1.08GB 11.3" active	4041.95
TM6030 5/133 16MB 1.35GB 12.1* active	4806.26
A HEWLETT	

A HEWLETT	
Vectra 500 Series Desktop	s
510CD 5/120 16MB 1.28GB 6X CD	1616.99
Vectra 500 Series Mini-towe	ers
515CCx 5/120 16MB 1.28GB 6X CD	1819.45
515CD 5/133 16MB 1.62GB 6X CD	1828.75
515MCx 5/133 16MB 1.62GB 6X CD	2064.29
515MCx 5/150 16MB 1.62GB 6X CD	2174.31
515MCx 5/166 16MB 1.62GB 6X CD	

Canon	
BJ30 monochrome	265,5
BJC70	293.8
BJC210	149.0
BJC610	429.0
BJC4100	229.0
MultiPASS 800 print/copy/scan/fax	499.0
MultiPASS C2500 color print/copy/scan/fax	599.0

FPSON

AP5000+ DFX5000-

DFX8000	2340.10
FX870	289.45
FX1170	376.56
LQ870	
LQ2070	383.04
LQ2170	599.00
LX300	
Stylus 1500	995.00
Stylus Color 500	279.00
Stylus Color II	279.00
Stylus Color IIs	157.06
Stylus Pro color	379.00
Stylus Pro XL color	1799.00
W HEWLETT PACKARD	
HP DeskJet 400 printer	198,56
HP DeskJet 340 portable inkjet printer	293.84
HP DeskJet 682C color printer	299.00
HP DeskJet 820Cse color printer	399.00
HP LaserJet 5L Xtra printer	579.00
HP LaserJet 5P printer	601 01
HP CaserJet or printer	404.01
HP OfficeJet inkjet fax/copier/printer	939.00
HP OfficeJet 350 inkjet fax/copier/print	ter/scannera49.00

LEXMARK

Open LA+	COLUMN TO STREET STREET STREET
Optra N	2686.1
Optra R+	1253.6
Optra Rt+	1481.5
OKIDATA	
184 Turbo	228.2
320 Turbo	317.1
321 Turbo	
ML395	
ML520	
ML521	
ML590	
ML591	603.6
Okipage 4w	299.0
OL600e	
OL610e/PS	
OL810E	
~~··	

IAIRDGIOI.	
540MB EIDE	164.68
1.6GB Fast-ATA	246.5
2.0GB Fast-ATA	275.3

Seagate

44/1

631MB Fast-ATA	
1.08GB Fast-ATA2	196.0
1.08GB Fast SCSI-2	265.23
2.1GB Fast ATA-2	
2.14GB Fast SCSI-2	736.68
2.1GB ultra wide SCSI-3	573.1
4.29GB Fast SCSI-2	988,7
9GB Fast SCSI-2	1965.49
1.00	The state of the s

WESTERN DIGITAL Caviar 1.2GB EIDE Caviar 1.62GB EIDE Caviar 2.1GB EIDE-2 Caviar 2.5GB EIDE-2

Hayes	
ACCURA 366 V.34 internal w/fax	141.13
ACCURA 366 V.34 external w/fax	149.36
ACCURA 366 DSVD internal	201.80
ACCURA 366 DSVD external	225.38
ACCURA 366 V.34 internal voice	158,77
OPTIMA 366 Business Modern external	238.48

MOTOHOLA	
BitSURFR ISDN adapter internal	263.97
BitSURFR ISDN adapter external	263.63
BitSURFR Pro ISDN terminal adapter	345.90
ModemSURFR V.34 28.8 internal	111.39
ModemSURFR V.34 28.8 external	127.02
OnlineSURFR V.34 28.8 internal	132.89
OnlineSURFR V.34 28.8 external	151.71
VoiceSURFR V.34 28.8 internal	157.97
PRACTICAL PERIFFICIALS.	

14.4 internal w/tax 14.4 Mini-tower w/ V.34 28.8 interna V.34 28.8 Mini-to

W-Robotics

14.4 internal w/lax	96.52
14.4 external w/fax	113.62
V.34 28.8 internal w/fax	149.48
V.34 28.8 external w/fax	169.29
Voice V.34 28.8 Internal w/fax	169,29
Voice V.34 28.8 external w/fax	189.40
Winmodem V.34 28.8 internal w/fax	
ISDN 128K terminal adapter	
Courier Series	
V.34 28.8 internal w/fax	238.90
V.34 28.8 external w/fax	275.65
I-modern ISDN V.34 faxmodern internal	
I-modern ISDN V.34 faxmodern external	488.41

APC

Back-UPS Office		138,33
Back-UPS Pro 280 PNP	Protect	145,12
Back-UPS Pro 420 PNP	MES	241.90
Back-UPS Pro 650 PNP	5000 A 495.65	288.56
Smart-UPS 700	SCHOOL STREET	362.89
Smart-UPS 1000	Secretary and the second	495,46
Smart-UPS 1400	7020	521.50
SurgeArrest Personal	Shrotter John	16,14
SurgeArrest Professional		26.18
SurgeArrest Network		29.24

BC250	93.2	
BC PERS 420	126.4	
BC PERS 500	156.2	
BC PRO 550	181.4	
BC PRO 675	213.2	,
BC PRO 850	275.8	
BC PRO 1050	509.2	
OmniSmart 280 PNP	33.8	
OmniSmart 450 PNP	204.7	
OmniSmart 675 PNP	234.2	

Call for a free **CDW**[®] catalog

CDW® sells for less and services you better!"

(4CDW)

Visit our web site! www.cdw.com

PERFORMANCE



DATA INTEGRITY

Today's applications require higher performance and reliability from your storage configurations. Consan RAID systems are your storage solutions.

We have specialized in mass storage configurations for nine years and Consan designs the highest performing RAID configurations to meet your most demanding needs.

- HARDWARE+SOFTWARE RAIDS—All Raid levels for all platforms.
- HOT SWAP Optional hot swap drives, power supplies, and fan.
- DIGITAL VIDEO+CAD—Digital Video + CAD Approved with most applications.
- NETWORK SERVERS Combining performance and data integrity.

CONSAN builds Seagate based solutions as well as a full line of tape, optical and CDR storage products. For more information, call Consan toll-free at:

1-800-221-6732.





1320 TOWER ROAD SCHAUMBURG, IL 60173 TEL: 847-519-1060 FAX: 847-519-1248

PLANO, TX 75074 TEL: 214-422-3392



@ 1996 Consan, Inc. Seagate and the Seagate logo are registered trademarks of Seagate Technology, Inc.

Switch to any Server by Name from an On-Screen Display!



Now, switching computers with your AutoBoot keyboard/video/mouse switch is even easier. Just call up the Director menu, choose a computer and you're done! No buttons to push or codes to remember. Since you name your computers whatever you like, picking one from the menu is a snap. Keep your current computer name on screen at all times, or for just a few seconds after switching.

Best of all, the Director works with any platform, operating system or software you use. All you need is a Commander product with keyboard control capability. And, because it's an add-on product to your existing Commander, there's no software to install.

With the Director, making the switch to Cybex is easier

COME SEE US AT than ever!

Networks Expo in Dallas, TX Oct. 29-31 Booth #1591

COMDEX/Fall "96 in Las Vegas NV. Nov. 18-22 at Booth #L4254



Cybex Computer Products Corporation 4912 Research Drive • Huntsville, AL 35805 USA 1-800-932-9239 • FAX (205) 430-4030 http://www.cybex.com

PC is a registered trademark of International Business Machines Corp. Macintosh is a registered trademark of Apple Computer, Inc. Sun is a trademark of Sun Microsystems. Cybex, Commander, AutoBoot and 4xP are trademarks of Cybex Computer Products Corporation.

4Meg x 9 (9 chip) 4Meg x 9 16Meg x 9 (9 chip)		1	1	41.00 179.00	39.00 169.00	39.00 169.00	14.00
72 PIN	SIMMS	(FPM,	EDO)	SO	DIM	MS (79)	144 pin)
256 x 36 t mg 512 x 36 t mg 1 mag x 36 4 mg 2 x 36 8 mg 4 x 36 16 mg 6 x 36 32 mg 16 x 36 84 mg 2 x 32 8 mg 4 x 32 16 mg 8 x 32 22 mg	50NS 19.00 36.00 44.00 74.00 124.00 249.00 34.00 54.00 109.00 199.00	70NS 19:00 34:00 39:00 (9:00 119:00 244:00 689:00 29:00 49:00 104:00 189:60	80NS 19.00 34.00 39.00 60.00 119.00 244.00 689.00 49.00 104.00 189.00	72 Pin, 3 72 Pin, 3 72 Pin, 5 72 Pin, 5 72 Pin, 5 72 Pin, 5 72 Pin, 144 Pin	3V 3V 3V 3V 33V 33V 33V 33V 33V 33V 4D0 33V 6D0 33V 6D0	4Meu 6Meg 16Meg 4Meg 16Meg 16Meg 16Meg 16Meg 12Meg 8Meg 19Meg 19Meg 23Meg	89.00 189.00 189.00 189.00 189.00 189.00 189.00 189.00 189.00 189.00 189.00 189.00

1 x 32 4 mg EDO 2 x 32 8 mg EDO 4 x 32 16 mg EDO 8 x 32 32 mg EDO	36.00 54.00 109.00 199.00	29.00 29.00 49.00 154.00 189.00	499.00 29.00 49.00 104.00 199.00	144 Pin, 53 144 Pin, 53 144 Pin, 53 144 Pin, 53	EDS 19	Meg 1553.02 Meg 89.00 Meg 166.00 Meg 1937.00
ECC Simm	s/Dimm	s Mod	ules	D	IMMS	(168 pin)
Peolium Pro 72 Pin (in 16Meg 32Meg 64Meg 128Meg 3.3V ECC			. 319.00 . 2349.00 . 4528.00	1 x 64 2 x 64 4 x 64 8 x 64 16x64	8Meg 16Meg 32Meg 64Meg 128Meg	59.00 111.00 225.50 449.00 1995.00
16Meg 32Meg			209.00	3.3V SDRA 3.3V SDRA 3.3V SDRA	M 16Meg	109.00 209.00 449.00

AST	MEMOR	Y	
MODEL, Bravo UC-Series, Bravo MT, Bravo MS, MS-L, Advantage Pro DX33, SX25	AMT. UPGRADED 4Msq 8Msq 16Msq 32Msc	AST PART # 560967-002 560967-003 560967-004 560967-005	PRICE 34.00 68.00 119.00 278.00
Premmia LX P/60, MX4/56d, 4/100T, P/60	8 Meg 16 Meg 32 Meg 64 Meg	500967-003 501340-002 500967-005 501569-001	78.00 180.00 278.00 649.00
Premmia 4133, 41335, 4/504, 4/604 Premmia SE 4/33, 4/564, P/60 Premmia MTE 4/33, 4/564, P/60 Maxhattan G, V Series Server	8 Meg 16 Meg 32 Meg 64 Meg	501159-002 501159-003 501159-004 501159-005	89.00 149.00 329.00 859.00
Power Premium 3/33, 4/33, 4/335, 4/504, 4/66d Premium 486/25, 486/35E, 486/33, 486/33E Premium 386/33TE, 486/35TE, 496/33TE Prem. II 386/25, 386/33, 486/33, 486 SX/20 Brave 486/25, 486/33	SMeg Kit	500780-001	168.00 48.00

Preminia LX P/60, MX4/66d, 4/100T, P/60	16 Meg	501340-002	78.00
	16 Meg	501340-002	180.00
	32 Meg	500987-005	278.00
Premmia 4133, 41335, 4506, 460d Premmia SE 4/33, 4566, P60 Premmia SE 4/33, 4566, P60 Premmia MTE 4/33, 4666, P60 Marinatan G, V Series Server Power Premium 3/33, 4351, 4/305, 4/506, 4/666 Premium 3/68/55, 486/55, 486/33, 486/33E Premium 3/68/53TE, 486/25TE, 486/33TE Premium 3/68/53 3/66/3, 486/33, 486 SX/20	64 Meg 8 Meg 16 Meg 32 Meg 64 Meg	501589-001 501159-002 501159-003 501159-004 501159-005 500789-001	649 00 89 00 149 00 329 00 859 00 168 00
Bravo 486/25, 486/33 Advantage 486/25, 486/33, 486/33P, 486 SX/20	₹ Mag Kit	500780-005	48.00
Premium SE4/22	8Meg Kit/16MegKit	500780-001	118.00
Premium SE 4/50, d, 6/5d, P/6/5		500780-003	19.00
Prem. 386/33T, 385 SX16, Prem.II 386SX.20, 38		500780-004	59.00
Premmia GX P/90, P/100		501565-001.501566-001	98/178
AST Cupid Board	32Meg Kit/64Meg Kit	501567-001/501568-001	278/518
	0-32 Meg	500818-001	159.00

mbra NC 425SL mbra N Series mbra SN Series mbra N-75, N-100	2/4/8 Mog 4/8/72/16 Mag 4/16 Meg 4/8/16	69/109/189 99/169/269/339 79/219 99/129/219
and the second second second		

e also sell Memory for: Dell, Gateway, HP, DEC, Sun, Zenith, Acer, NEC and Epson

Sales/Orders: latradesis@aol.com

Deskpro 386S	1Meg Module/4Meg Module 1Meg Board/4Meg Board	39/89 99/201
Deskoro 300 25E/20E	1Mag Module/4Meg Module	39/89
Designo and Zatrizut	TMeg Board 4 Meg Board	99/201
Daskpio 386/25, 20		
	1Mag Module/4Meg Module	79/129
Deskpro System Pro 386/33, 486/25, 486/50L		29/89/293
Deskpro 4/661, 4/331, 4/2515, 37331, 3/251	2/4/8Meg	56/89/169
Daskpro "M" Series	Expansion Board SK	\$19
Deskpro 450, 466, 4100, 575, 590, 5120, 513		49/59/149/299
Deskpro XE 4335, 450, 466	2/4/BMeg	49/69/99
Deskpro XE 560 (pains)	4/8/16/32/64Meg	39/69/139/299/796
Deskpro XL450, 466, XL560, x556, XL575, 51	100 x1590 4/8/16/32/64Meg	39/99/139/299/795
Presano 433, CDS520, CDJV520, CDL524, CD 660, CDS660, CDS720, CDS724, CD	\$744, CDS860	39/69/139/295
GD5920, CDTV929, 924, GDS924, CE		14 14 15 16 16 16 16 16 16 16 16 16 16 16 16 16
Presario 400 Series, 600 Series, 800 Series	4/8/16/32Meg	49/89/139/266
Presario CDS774, CDS972, CDS982, CDTV97: CDS992, 7152, 7170, 7180, 8546, 92		49/89/139/265
Profittes 4/25S, 4/33, 4/33S, 4/50, 4/66, CDS	1/2/4/BMeg	19/29/49/99
Profitting MT 4/335, 4/50, 4/66, Entranced 4/335	4/506, 4/50, 4/66 4/8/16/32 Meg	29/49/104/185
Prolima 450, 466, 4100, 575, 590, 5120, 575 575 mm; 5100 mm; 5133 mm	.590,5120 4/8/16/32Meg	29/49/104/189
Proliant 1500 5/75, 5/100, 1500R 5/75, 5100	(install in pairs) 4/8/16/32Meg	29/49/104/185
Proxigera 300, 575, 580, 560 5/96, 500 5/120	(Install in pairs) 4/8/16/32Mag	29/49/104/189
	(install in pairs) 4/8/16/32	29/49/10/1/85
Proteint 2000 486/50, 5/66, 5/90, 2000R 5/66, 5 4000 486/50, 5/66, 5/90, 5/100, 4000	790 (Install in pairs) 4/8/16/32	29/49/104/185

COMPAQ LAPTOPS & NOTEBOOKS

Armada 1108/4100 EHe 5000, 5200	EMeg/TEMeg/22Meg/32Meg/32Meg		99/149/266/513
LTE/3865/20	ameg-raming-active-youngs 4Meg Modute	121125-002	79.00
LTE LITE/20, 25, 25C	4Meg Module	129769-002	79.00
LTE LITE/20, 25, 25C	8Meg Module	129769-003	119.00
LTE LITE/20, 25, 25C	16Meg Modulin	129769-004	219.00
LTE LITE 425C/33C/25E/25L	4Meg Module	142337-002	49.00
LTE LITE 425C/33C/25E/25E	8Meg Module	142337-003	89.00
LTE LITE 425C/33C/25E/25L	16Meg Module	142337-004	219.00
SLT/386	4Meg Module	118305-001	99.00
Concerto, LTE Elite:	4Meg	144790-001	59.80
	8Meg	144790-002	99.00
Control of the contro	16Meg	144790-003	189.00
Contura 320, 325	-tMog	139498-001	99.00
	BMog	139499-001	109.00
Comura 400, 410, 420, 430	4Meg/Mileg/16Meg		49/199/189
Contura 4/25, 4/25C, 4/25CK	4Meg	146520-001	79.00
	aMag	146521-001	99.00
To the same of the same of	16Meg	146531-001	199.00
Aero 4/25, 4/33	4Meg	190532-001	89.00
	aMeg/16Meg	190597-001	99/189

		HA	RD	DISK	DRIV	ES		
e GIG I GIG	SEAGATE	\$207 299	1.0 GIG 1.2 GIG 1.6 GIG 2.0 GIG		\$179 199 239 276	850MB 1,2 GIG	WESTERN DIGITAL AC2850 AC31200 AC31600 \$339 2.5 GIG	\$11

HARD DRIVES FOR LAPTOP & NOTEBOOK

HM THINKPAD 355, 360, 370,		Versa E. V. M. P - 1.3 GIG	\$769	UNIVERSAL NOTEBOOKS A	
750, 755 - 810mg	3499	2.1 GIG	889	810mg	541
1.3 G/G	786	Versa 2000,4000 - 810mg	\$499	1.3 GIG	78
2.1 GIG	889	1.3 GIG	76E	2.1 GIG	84
THINKPAD 760 - 1.3 GIG	\$768	TOSHIBA			
COMPAG		4700/4800 810mg	5499		
LTE 5000,5100-810m	Call	1.3 GIG	. 786		
1.3 GIG	Call	Teora 1700 - 810mg	\$749		

CUSTOMER SERVICE & TECHNICAL: OPEN M-F, 9-4 PST All products brand new & guaranteed • We buy excess inventory



Prices & Availability
Mon-Fri, 8:00 a.m. to 5:00 p.m. PST Sat. 10:00 a.m. to 12:00 noon Without Notice

FLASH RAM (ATA) — Works with Digital Cameras Kodak DC-50 & More 4 Meg-169 8 Meg-239 16Meg-399 20Meg & 40Meg-CALL NON ATA-CALL

LASER PRINTER MEMORY UPGRADES

PCMCIA VERSION 2.0

ZA-309-1 ZA-4-4

69/199/1 69/199/1 69/199/1 69/109/1 79/1

	Bd.	258k	- 1	2	- 3	3.5	- 4	- 5	6	В	16	
Brother 630, 631, 641, 645	-	-	69	93	-	-	_	-	-	-	-	
Carrott LBP 430	-	-	39	-	-	-	49	-	-	-	-	
Carron LBP 860: 1260	-	-	-	39			69	-	-	94	144	3
Caron LBP4, 4LRs, 4rkin	-	-	129	179	-	-	172	-	-		100	
Epson 6000, Action Laser	-		100	129	-		229	- 10	-	190		
Epson Action Laser 1100, 1600	500	-	659	70		-	99	- 198		.199	359	
Epson Action Laser II	-	-	74	117	173			272	-	100	- 14	
Feeco 8000, 1800, 4000, 4100, 4300	-		86		173			272		-	-	
Epson 1000, 1500, 5000, 5200	-	- 2		20	110	75	178		-	-	-	
HP 2, 2D-	-		-	40		-	100		-	-	-	
HP 3, 30, 3P, 2P 2P+	-	- 12	-	69	-	-	99		-		-	
HP 4, 4M, 4St, 4StMX	-	- 2	-	49	12	100	58		-	99		
HP 4P, 4PLUS, 4MPm 1600, 1600CN	1		19	29			49			89		
HP 4L			34	4.0			40			62	- DE	
HP 351		- 3	39	1 2			69		-	99	-	
HP SL			49	74	15		89			199		
HP SP, SMP, 4V, 4MV		- 2	19	38		- 2	49			89	124	
HP Design Jet 600, 650, 200			10	39			45	- 1		88	139	2
HP Deskint 580, 500C, 510, 550, 560	-	24	-	- 20	- 5	-	40			90	100	
HP Desket 1200C, 1200C/P	-	- 24		39		-	49	-	-	89	-	
HP Paintet XL300	54		- 3	-23	- 12		69	- 13		144	200	
IBM Laper 4019, 4019E	34		-			139	1111			144	539	
IBM Laser 4029, 4037	-	- 3			- 5	140	119	-	-		-	
IBM Laser 4029, 4079				69		-	89		-	400		
Konica LP-3110, 3115	-	- 0	119		239	-	09	-	-	189	-	
Abrica D-3110, 3115	-		158	189	238	-				-	-	
Lexmark Medley 4C, 4x, 45X	-	-	CHI	Call	Call		59		-	64	139	- 12
Lexmark, Optra L. LX, R. RX	-					-		-	-	194		£
Lexmark Valuwriter 300,600		-	29	39	-	-	89	-	-	-	-04	
Lexmark Winwitter 200, 480, 600	-	-	29	39	-	-	89	-	-	-	-	
NEC 90, 290	*	-	. 10	88	-	-	49		. (-	-	
NEC 95, 97	-	. 4	100	79	1.00	de		-	(90	-	-	
Okt 400	-	-	17	79			-		100	-	-	
Oki 400E, 400EX, 410E, 410EX	-	-	89	109	169	100	189	-	-	-	100	
Oki 810E, EX, 60BE, EX, 610E, EX	-	-	29	39	-	-	79	-	-	119	179	
Oki 830, 840	-	-	-0	89	-	-	-	-	-	-	-	
Oki 2350, 2450	-	-	Calt	CHI	-	-	NOT.	-	-	-	-	
Packard Bell PS 9500	-	-	114	139	-	-	227	-	-	-	-	
Packard Bell 9815	-	-	-	139	-	-	229	-	-	-	-	
Panasonic 4420/4450i	-	-	-	- 99	-	-	169	-	-	-	-	
Panasonic 4410/4430		-	40	89	-		129		-	-		
Pariasonic 4450	-	-	89			dec	-	- 01	- (80	-	100	
Pariasonic 4400/5400	-		89	. 99			189	100		-	-	
Panasonic 4440, 5410, 6500	-	100	79	99	-	-	159	- 100	dan	- tex	-	
Sharp 9400, 9460, 9600, 9700E	-	-	69	99		-	149	-	-	-	-	
Sharp 9500, E, H, 9700, H	-	-	79	-	-	-	259	-	-	-	-	
TI XL/PS17/PS35	-	-	49	-		-	-	-	-	-	-	
Ti Microtaser Pro E. Powerpro, Pro 660	-	-	89	129	-	-	189	-	-	329	-	
T) Microwriter	-	_	79	119	-	-		-	-	-	-	

310-539-0019 FAX: 310-539-5844

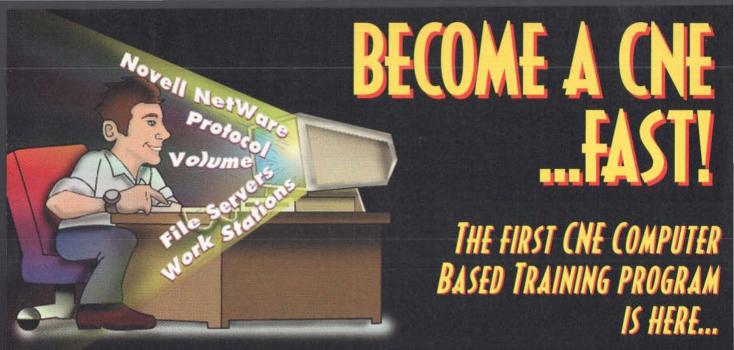
SECURITY WILL CALL WINDOW NOW OPEN

CALL TOLL FREE

(US and Canada)

Customer Service: latradecsd@aol.com

Price Inquiries: latradeing@aol.com



he AllMicro CNE Self-Study Course™ is the first 100% Computer Based Training (CBT) program to fully prepare you for Novell's CNE exams. Its innovative design provides fast, effective and convenient training to anyone wishing to become a Certified NetWare Engineer, even when hampered by a busy schedule. Our CNE CBT allows you to learn and practice everything you'll need for full NetWare certification.

- · All on one CD
- Interactive NetWare simulation for hands-on exercises
- Study at your own pace
- Hundreds of practice questions
- Priced below competitive products
- Everything you need to prepare for Novell's test!

Effective!

Through the use of interactive exercises, you'll be able to gain practical handson knowledge under simulated situations without the need for a working network.

AllMicro's CNE CBT ensures that when you complete your training you'll be fully prepared to pass your CNE exams, and best of all, you'll be ready and confident to go into the workplace and perform vital CNE functions.

Convenient!

Our CNE CBT program offers you flexibility and portability unmatched by traditional training methods. You will study when and where it's convenient, at your own pace using a step-by-step format for either NetWare 3.1x or 4.1!

Affordable!

The AllMicro CNE Self-Study Course is priced far below other competitive training packages, so you can now get top quality training at a price you can easily afford.

Added Bonus!

The AllMicro CNE Self-Study Course even comes with the required Micro House Technical Library™. You'll have at your fingertips the latest specifications, diagrams, hardware settings, component locations.

configurations, and other hardware technical information, all on CD-ROM. Familiarity with the Technical Library is required for full certification.

Don't put your career on hold any longer! Get the AllMicro **CNE Self-Study Course and** get certified...FAST!

COURSE MODULES INCLUDE:

- Administration v3.1x
- Advanced Administration v3.1x

- TCP/IPTransport for NetWare Networking Technologies
- 3.1x Installation & Configuration (#802) NetWare 3.1x to 4.1 Update
 Service & Support for NetWare (#801)
 *NetWare 4.1 course also ava *NetWare 4.1 course also available

MICRO HOUSE

NOTE: As of 6/30/96 current CNE's will lose new 3.1x-4.1 update test. We have the course!

their certification unless they pass Novell's

CALL TODAY!!

For more information about our limited time discount pricing CALL: 1-800-653-4933

INTERNATIONAL: (813) 539-7283 • FAX (813) 531-0200 FOREFRONT/AllMicro

F. Self-Study Course

The most effective CNE computer training program available for corporations & individuals

18820 U.S. HWY. 19N., #215, CLEARWATER, FL 34624

Circle 255 on Inquiry Card.

AllMicro

elivering Grea mputer Optic

SPORTSTER "33.6Kbps Data" Fax modem with Personal Voice Mail

9999 G

Description

Premium Cable Assemblies (Fully Shielded)

Printer Cable DB25-36 Pin Centronics, 6ft.

Bi-Directional EPP Printer Cables, 6 ft.

DB25, 25 Line Cable M-M or M-F, 6 ft.

15 Pin High Density, Male to Male, 6 ft. 5 Pin Din Male to Male , 6 ft. AT Keyboard Extension Cable, 6 ft.

AT Monitor Extension Cable, (9M-9F) 6 ft. PS2 Monitor Extension Cable, 6 ft.

Monitor power ext. cable, 6 ft.

50-Pin Centronics (M) - 50-Pin Half Pitch

RS-232 Null Modem Adapter (25S-25P or 9S-9P)

10Base T Cables (Hi-Flex Gray, Red, Green, Blue, Black, Yellow)

PS2 Keyboard Extension Cable, 6 ft.

AT to Modem, 6 ft. (9S-25P)

PC power cable, 6 ft.

PC power adapter cable

SCSI-III, 18" Internal Cable

25-pin M-M or F-F ultrathin

9-pin M-M or F-F ultrathin

Description Without Boot

Puts all the convenience of an answering machine, speakerphone, fax machine and reliable modern in one compact unit - and its easy to use, right from your home or office PC Sportster[®]

- Supports true ITU-T V.34 data transmission at 33.6Kbps.
- Plug and Play design. 16550 UART for improved performance
- Speakerphone designed with Microphone Included.
- Multiple Voice Mail Boxes for convenient & confidential access.
- Fax on Demand Menu features ability for caller to choose requests.
- · Quick, Remote Fax Retrieval! Ability to signal an alphanumeric pager!
- Full Duplex Speakerphone lets you talk and listen without interruptions. · Caller ID and Distinctive Ring so you'll always know whose calling.
- 5 Year Limited Mfg Warranty: Factory Repair or Replacement



SPORT-VI SPORT-VE 33.6Kbps External Faxmodem with Voice Mail

33.6Kbps Internal Faxmodem with Voice Mail

:179 209

Reliable & Affordable Ethernet Networking Products!

10BASE-T/BNC Adapter Card features Plug 'N Play I/O, interrupt and PROM address. NE2000/IEEE802.3 compliant with LED indicators for activity and link detection. Supports NOVELL, Microsoft, Artisoft, FTP and PC/NFS. Compatible with all Bus systems, 10Mbps transfer and is FCC certified

- Plug 'N Play Design
- -I/O 300h,320h,340h & 360h
- -Interrupt 2,3,4,5,10,12,15

AE-200-PNP-CE AE-380PCI

AEF-350TX UTP16/L UTP8SL

10BaseT/BNC Adap.

16 Port 10BaseT Hub

BEST 32-Bit PCI 10Base T Adap. 50 PCI 10BaseT 10/100 Mbps Adap. 89 190 96 8 Port 10BaseT Hub

ADDTRON

Part#

25M*-6

5MM-6

KEC-6

ATM-6

ACPC-02

ACPC-03 ACPC-04

SCSI-III-1

Gender Changers - Ultrathin

3 ft.

7 ft.

15 ft

25 ft

SCSI-II

NMA-*

TGC-25

Category

73-66 -3

73-66 -7 73-66_-15

73-66_-25

73-66_-50

TGC-9*

Part#

PPC301-6

PPC1284-6

HD15MM-6

PS2KEC-6

MEC-6 PS2MEC-6

16-Port 10BASET Concentrator



- Reliable
- Compact
- Cost-effective!

Offers Sixteen 10BaseT ports with RJ45 connectors, One BNC and One AUI port for cascading hubs or connection to existing backbone, has 21 LED indicators for confirming status and operations. IEEE802.3 compliant.

BEN220 BOCAHUB-16 PLUS 10Base-T Concentrator BEN210 BOCAHUB-8 (Eight Port) 10Base-T Concentrator

Each

12.95

3.99

4.99

3 39

2.99

3.39

2.49

2.29

3 69

29.95

29.95

\$2.99

2.69

10-49

\$3,47

4.36

6.29

2.99

	or sommen incompanion	PROPERTY AND ADDRESS OF	- 1-33	100-555	1000
/DC5-4	Level 5, 4 Pair, Unshielded CL-2 PVC		\$.15	\$.10	\$.09
/DC5-4P	Level 5, 4 Pair, Plenum		.45	.30	.26
RG58U	RG-58U Coaxial Systems PVC Cable		.15	.10	.09

10+

\$2.54

11.99

3.51

4.24

2.54

2.54

2 99

2.54

2.99

2.60

2.24

2.06

3 32

28.50

28.50

\$2.69

2.42

504

\$3.18

4.00

5.77

7 97

2.69

Network CPN Switch

MASTER VIEW allows one console to access six servers (CPUs). Supports VGA to Multisync, has built-in buffer, is Daisy Chainable, AutoScan or Manual selection (3-40 sec. scan interval), Perfect for computer room access to fileservers CS-106 MasterView (AT Only), 1 to 6 279 CS-104 AT/PS2 MasterView, 1 to 4 CS-102 AT MasterView, 1 to 2 CS-122 PS/2 MasterView (1 to 2) 219 219 VIDEO SEPARATOR - Video Signal is enhanced

for distance up to 210 ft. (Daisy Chainable) VS-104 4 to 1 \$99 VS-108 8 to 1 159

Parallel Line Extender PLE-100 DB25 Male to DB25 Male, 30' DB25 Male to 36 P Male, 30' PLE-110



280VA, 175Watts, 2 Outlets

BCPRO675 BCINT280

BCINT675 OMNIPRO450

Protector (Wires 1, 2, 3, 6)

BCPER280

(Pins 1-8, 20)

450VA, 280Watts, 4 Outlets



230 203

\$97

231

99

9.56 8.69 15.20 13 82 12 67 Enjoy sharp color & clarity!

1-9

\$3.82

4.80

6.92

14" SVGA Monitor features 1024x768 resolution with 28mm aperature. Energy Star compliant with One-Year Mfg. Warranty.

MON-08 14" :259 **MON-13** 15" 329 **MON-11**

MOTHERBOARD PREMIO Quality, Performance & Reliability, Novell approved offering SiS chipset, AMI Plug 'n Play Flash BIOS, clock generator for fast speed changes and meets EPA Energy Star Standards. -256kB cache upgradeable to 1Mb -Four 72-pin SIMM sockets support EDO with up to 128Mb. -Built-In Controller support 4 IDE drives (up to 16.6MBps transfer) -Features 4 PCI Master & 4 ISA Slots -Integrated I/O features EPP/ECP bidirectional parallel port, Two 16550 UART Serial ports w/16 byte FIFO, LBA

100MHz PENTIUM

IDE drive support over 528Mb MBPEN-100 PREMIO Pentium Motherboard

100MHz CPU MBDX4P120A 486 DX4 "Green"

Mainboard with 120MHz AMD CPU

D10BT RJ45 Ethernet, AS400/Sys3x DB25 Serial DB25, RS232 Protector

SUPER8 8 outlet, 18,000 amp spike protect., 6' cord, 2 yr.warr. **IB6ULTRA** 6 outlet, 3 filter banks, LEDs, 6' cord, \$25K Ult. Ins. 52

ISOTELULT6 6 outlet, 3 filter banks, LEDs, \$25K Ult. Ins.

CC16-P Command Console, 6 outlets, Fax/Modem protection., \$10K Ult. Ins. 69 VISA

1-800-531-5369

Hours 7:30am-6:30pm M-F

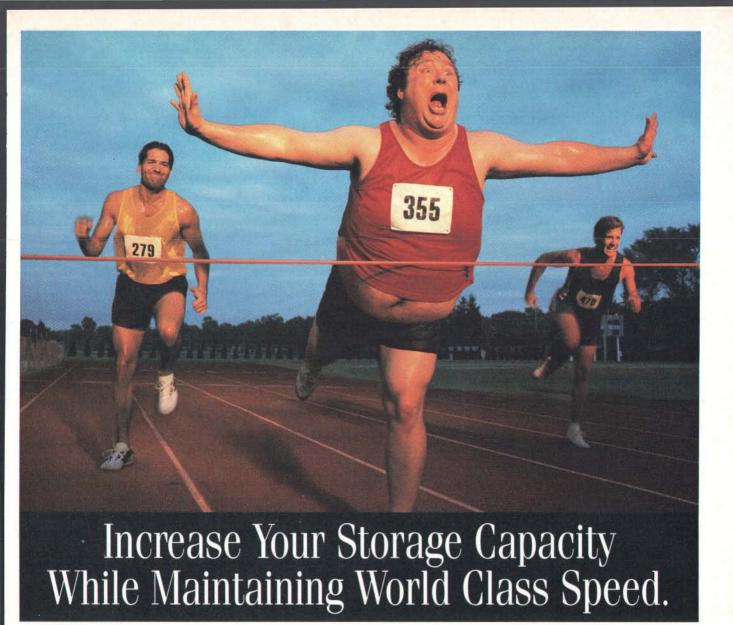
COMPANATE, INSTITUTIONAL & COVERNMENT POS WELCOME. NET 20 TERMS AVAILABLE UPON APPROVAL TEFIMS: For C.O.D. orders and \$5 per package. Minimum \$25. Cash or Cashiers Check only. For orders under \$99 add \$3 handing charge. All shipping is FOB San Antonio, Texas and will be added to your invoice. Texas residents add 7:3/4% sales tax. All returns require RIMAI and must be returned in original condition. A 15% restocking few will be assessed on product returned in non-resaleab condition. Prices subject to change without notice. We are not responsible for typographical errors.

Texas Locations

11342 IH-35 North San Antonio, (210) 637-3200 • FAX: (210) 637-3264 10731 Gulfdale San Antonio, T)

(210) 828-0503 • FAX: (210) 340-2409 10705 Metric Blvd. · Austin, TX (512) 832-9131 • FAX: (512) 835-1328 15207 Midway Road - Dallas, TX (972) 386-8882 • FAX: (972) 386-9182

2650 S.P.I.D. Corpus Christi, TX (512) 814-8882 • FAX: (512) 814-8812





Transfers data 3 times faster than other portables. It's a clear-cut victory for the backpack 8000t, the fastest tape backup system in the field. It has a big 8GB capacity, and it's portable. This powerful drive transfers data at up to

30MB per minute. That's 3 times faster than you'll find elsewhere. Using a single Travan TR-4 tape, backup your large

hard drives in record time. But that's not all. Installation is a breeze. Plug the backpack 8000t into your printer port and your printer into the backpack. There are no

expensive card options to deal with.

Then unplug and take it with you to backup data on other PCs. The backpack 8000t gives great performance at a price well under external DAT drives.

Now that's what you call a winner!



Plugs into any standard printer port. Share data between portables, desktops and laptops.

8000t

MicroSolutions

The port-ability leader.

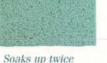
backpack

Free Travan[™] TR-4

Tape with purchase.

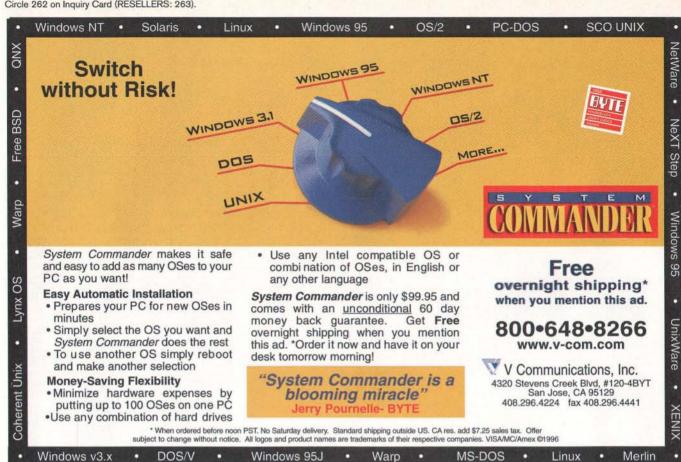
Limited Time Offer

Ph: 800-295-1214 (US and Canada) or 815-756-3411, Fax: 815-756-2928 Internet: www.micro-solutions.com



Soaks up twice as much data as a TR-3 drive.

Available through computer dealers, computer superstores, and mail order catalogs. Travan is a trademark of 3M Circle 243 on Inquiry Card (RESELLERS: 244).





Miami, FL Booth #C323

and

P.O. Box 742571 ♦ Houston, Texas 77274

TEL 713/933-7673 FAX 713/933-0044

Powered By Polywell

For CAD/CAM, Animation, Video Editing, Internet/Intranet,SQL Servers



Custom Configuration for high-end Alpha, Multi-processor Pentium Pro Server/Workstations.

PolyRaxx RackMounts Clustering Disk Array Portable Alpha, PCs



Optimized for: Video/Animation Authoring, Image Editing, Presentation, CAD/CAM, 3D Rendering, Internet/Intranet/SQL Server



433MHz (256-bit Alpha 21164A) Super System with 9GB HD 400MHz (256-bit Alpha 21164A) Advanced System with 4.3GB HD 300MHz (256-bit Alpha 21164) Standard System with 2.1GB HD 275MHz (128-bit Alpha 21064A) Basic System with 1.2GB HD

from \$9,995 from \$7,995 from \$4,995 from \$2,995



Quad Pentium Pro 4 x 200MHz SQL Server with 20GB Disk Array Dual Pentium Pro 2 x 200MHz SMP NT System with 4.3GB HD Single Pentium Pro 200MHz Standard NT Station with 2GB HD

from **\$19,950** from **\$4,500** from **\$2,500**



Pentium 200MHz High-Power PC with 2GB HD Pentium 166MHz Standard PC with 1.6GB HD Cyrix P166+ Budget PC with 1.2GB HD from **\$2,300** from **\$1,995** from **\$1,595**

Polywell Computers, Inc (800) 789-8027 www.polywell.com

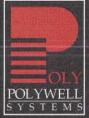
1461 San Mateo Ave., So. San Francisco, CA 94080, USA Tel: (415)583-7222 Fax: (415) 583-1974 E-Mail: info@polywell.com







Warranty and Support 5-year in-house labor, 2-year standard parts, 10-year toll free support 30-day money back guarantee



Circle 247 on Inquiry Card

Access any PC attached to the AutoBoot Commander 4xP or 1xP via telephone lines!

■ Works with any IBM PC/AT or 100% compatible computer

■ Built-in support for both text and VGA graphics viewing modes

- Full remote keyboard control allows you to control any attached PC as if you were actually there
- Perfect for offsite troubleshooting! Change the CMOS setup, reboot, or even cold-boot any attached PC
- Won't interfere with running applications or network software
- Upload or download files to any attached PC; transfer files or upgrade the software on any computer





COME SEE US AT COMDEX/Fall '96 in Las Vegas NV Nov. 18-22 at Booth #L4254



Cybex Computer Products Corporation 4912 Research Drive Huntsville, AL 35805 USA (205) 430-4000 (205) 430-4030 fax http://www.cybex.com/



Cybex, Commander, AutoBoot, 4xP, and 1xP are trademarks of Cybex Computer Products Corporation. IBM, PC, and PC/AT are registered trademarks of International Business Machines Corporation. Key-View is a trademark of Fox Network Systems, Inc. The Inc. 500 logo is a registered trademark of Goldhirsh Group, Inc.





Play CD-ROM programs. audio CDs, or use a PD cartridge for additional on-line storage.

Sure, you need to add function to your computer, but you don't need all those machines cluttering up your desk. The backpack pd/cd is a 3-in-1 mass storage solution that gives you a CD player and a removable cartridge storage drive. Backs up your

hard drive, too.

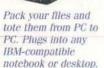
Now, just in case you're not up on PDs (optical Phase Disks), they're a new

kind of media you can read, write on, erase and remove an unlimited number of times. PDs look a lot like CDs, cost less

than magnetic cartridges, and can store 650MB. Also, they can't be accidentally erased by magnetic fields.

Another good thing is the easy installation. Plug the backpack pd/cd into your printer port and your printer into the backpack. That's it. Save your precious few expansion slots for something else.

And best of all, the backpack pd/cd is half the price



of those other solutions!

Available through computer dealers, computer superstores, and mail order catalogs. Seagate Software is a trademark of Seagate Technology, Inc.

Circle 245 on Inquiry Card (RESELLERS: 246).

Standard 650MB

optical disks can be erased. Use

over and over.

Seagate Software backup solution included with purchase price.





MicroSolutions The port-ability leader.

Ph: 800-295-1214 (US and Canada) or 815-756-3411, Fax: 815-756-2928 Internet: www.micro-solutions.com

IBM

ThinkPad Notebooks

Thinkpad 560 Series

TPAD	560C	5/100 8/810MB DSTN W95 \$call
TPAD	560C	5/100 8/810MB DSTN W95 \$call
TPAD	560C	5/100 8/810MB DSTN W95 \$call

Thinkpad 365 Series

TPAD	365XD	5/100	8/810MB 4XCD 10.4 DSTN	\$2285.79
TPAD	365XD	5/120	8/1.08MB 4XCD 11.3 DSTN .	\$2450.00
TPAD	365XD	5/120	8/1.08MB 4XCD 10.4 ACT	\$2918.75
TPAD	365E	5/100	8/540MB 10.4 DSTN W95	\$1699.33
TPAD	365ED	5/100	8/540MB 4XCD 10.4 DSTN	\$2035.42

Thinkpad 760 Series

TPAD 760ED	5/133 16MB EDO 12.1 ACT 1.2GB HD 4XC	\$call
TPAD 760E	5/120 8MB 1.2GB HD 12.1 TFT OPT CD	. \$4493.75
TPAD 760E	5/133 16MB EDO 1.08GB HD 12.1 TFT W95	. \$6130.21
TPAD 760E	5/120 8MB 1.2GB HD 12.1 TFT OPT CD	. \$4341.67
TPAD 760EL	5/133 16MB 1.08GB HD 12.1 TFT W95	. \$5469.79
TPAD 760ELD	5/100 8MB 810 MB HD 4XCD 12.1 TFT	. \$4445.83
TPAD 760EL	5/120 8MB 810MB HD 11.3 DSTN W95	. \$3333.33
TPAD 760EL	5/100 8MB 810MB HD 11.3 DSTN W95	. \$3148.96
Authorization makes		

Call us before you buy IBM

NOVELL Netware 3.12/4.1 Promotion 5/10/25/50/100/250 USERS

RED or WHITE BOX

call for best price

* free network card with Purchase over \$2500.00 *

Visit OurWeb Site

www.computerlane.com

HEWLETT PACKARD

Printers

HP DESKJET 340	\$295
HP DESKJET 600/660C	\$289/392
HP DESKJET 850C/1600C	\$495/call
HP LASERJET 5L/5P	\$485/call
HP LASERJET 4+/4M+	\$1340/1845
HP LASER 4V/4MV	\$1840/call
HP SCANJET 4S/4C	\$call/892
HP LASER 5SI/5SIMX	\$call
HP LASERJET 4+	\$1045
HP LASERJET 5/5M	\$1265/1699

COMPUTERS

VECTRA XII SYSTEMS

XU 6/15	0 16/1GBscsi+CD+Matrox Sstock	¢
XU 6/15	0 16/2GBscsi+CD+Matrox \$stock	¢
XU 6/20	0 16/1GBscsi+CD+Matrox \$stock	¢
XU 6/20	0 32/2GBscsi+CD+Matrox \$stock	¢
built i	Network card, Windows NT preloaded	

HP NETSERVER

Netserver	LC	P/100/133	3/166 32/	1gb+CI)	Scall
Netserver	LC	P/133/160	32/1gb-	CD		Scall
Netserver	LH	P/133/16	32mb,n	o disk, Ar	ray	\$call
Netserver	LH	P/133/16	6 32mb.n	o disk .		Scall
Netserver	LH	P/133/16	6 64mb.4	.2gb. /	irray .	Scall
steate pull 4				250	100	

HP VECTRA 500 COMPUTERS

515MCX	5/133	16/1.6	GB	
	MANUFACTOR .			answering
515MCX	5/166	16/1.6	GB	+cd+souni

.6 GB +cd+sound+phone answering+headphones +cd+sound+phone answering+headphones \$stock

COMPAQ

Notebook Systems

Armada Notebook Systems

Armada 1120CSTN	P100	8/810MB\$1850
Armada 1120CTFT	P100	8/810MB\$2179
Armada 4110CSTN	P100	8/810MB\$2450
Armada 4110CSTN	P100	8/810MB, CD.SOUND\$2850
Armada 4110CSTN	P120	8/810MB\$2999
Armada 4110CTFT	P120	8/810MB\$3685
Armada 4130CTFT	P133	8/1GB\$4350
LTE Notoboo		

LTE Notebook Systems

LTE 5150	P/75	8/810MB,	Active.	. \$stock
LTE 5250	P/100	8/810MB,	Active.	. \$stock
LTE 5250	P/120	16/1.3GB	Active	. \$stock
LTE 5280	P/133	16/1.3GB	Active	. \$stock

Deskpro 2000/4000/6000 Systems

Deakhin Fann	Milion, Oliverin	WILL !
Deskpro 2000	p/133, 16/1.2gb	\$1675
Deskpro 2000	p/166, 16/2.5gb	\$2175
Deskpro 2000	6/200, 16/2.5gb	\$2690
Deskpro 2000	6/200cd, 32/2.5gb	\$3299
Deskpro 4000	6/200, 32/2.5gb, cd	\$2799
Deskpro 4000	5/120, 8/1gh	\$1599
Deskpro 6000	5/166, 8/1gb, cds	. \$call
	6/200 22/2 Eath ad	

Compaq Server

Charlestotal Mantagaria Charlestotal Control	
Prosignia 300 Pentium 90,120,150Mhz	\$stock
Prosignia 500 Pentium 120,150Mhz	\$stock
Prolinat 5000 6/166 Model1	\$stock
Prolinat 5000 6/166 Model1A	\$stock
Prolinat 5000 6/200 Model2	\$stock
Prolinat 5000 6/200 Model2A	
Prolinal 5000 6/166 (rackmount Models)	
Prolinat 5000 6/200 (rackmount Models)	\$stock

Authorized Dealer & Service Center COMPAQ, IBM, TOSHIBA, HEWLETT PACKARD

TOSHIBA

1211000	DY4/19	4/00UMD	PRINCE
T2130CS	DX4/75	8/540MB	.\$stock
T2150CDS	DX4/75	4/540MB+CD+SOUND	.\$stock
T2150CDT	DX4/75	8/540MB+CD+SOUND	.\$stock
T2150CDT	DX4/75	4/540MB+CD+SOUND	.\$stock
T100CS	P/75	8/810MB	.\$stock
T400CDT	P/75	8/810MB+CD	.\$stock
T410CDT	P/90	8/810MB+CD	
T700CT	P/120	8/1.368	.\$stock
T710CDT	P/133	16/1.3GB+CD	.\$stock
T720CDT	P/133	16/1.3GB+CD	.\$stock
NEW R			
		8/810MB	Sstock
T110CT	P/100	8/810MB	Sstock

111000	E/100	O/DYUMB	SOILLY
T110CT	P/100	8/810MB	Sstock
T420CDS	P/100	8/810MB	Sstock
T420CDT	P/100	B/810MB	
T500CS	P/100	16/1.368	
T500CDT	P/100	16/1.3GB	Sstock
T610CT	P/90	B/810MB	.\$stock
T720CDT	P/133	16/1.3GB	Sstock
TTROCDT	PHSS	16/1 208	Scall

Also carry Toshiba Refurbished Models & Call for Price &

Specials of the Month

п	
	Matrox Millenium 2mb WRAM\$189.00
	Matrox Millenium 4mb WRAM\$250.00
	Matrox Millenium
l	MPEG Capture card \$call
١	Creative Lab
ı	Recordable CD-R 4210 \$599.00
I	Creative Lab 8X IDE CD \$119.00
	8X Parallel Port CD \$325.00
١	6X Parallel Port CD\$259.00
l	Creative Lab SB 32 PnP\$115.00
١	Panasonic 6X portable
l	CD-ROM drive\$379.00
	Epson Style 500 color printer\$369.00
	ZEBRA S-500
	Stripe barcode PR SER \$1175.00
	ZEBRA S-300
	Stripe barcode PR SER \$899.00

Kodak DC 40 Digital Camera	.\$523.00
Kodak DC 50 Digital Camera	.\$859.00
Microtek Scanmaker E6 scanner	.\$549.00
Seiko Smart Business Card Read	er\$call
Sportster 33.3 Fax/Modem Voice	.\$169.00
Sportster 33.3 win modem	.\$119.00
Zip Drive 100 MB	.\$195.00
Jaz 1GB drive	.\$365.00
Tapestor 8GB internal SCSI Drive	.\$355.00
Pentium Motherboard 512k pipline cache	.\$139.00
Ami Pentium Pro Merlin motherboard	.\$640.00
Intel Pentium Pro Venice motherboard	.\$345.00

Window NT Workstation 4.0	.\$278.00
Mag 15" SVGA Color Monitor .	.\$345.00
NEC XV+ 17" svga monitor	.\$782.00
Adaptec 2940 PCI SCSI	\$call
PCMCIA 28.8 Megahertz	.\$234.00
PCMCIA Xircom 2.8 fax modem	.\$219.00
Black computer case &	
Monitors	
14" 1024x768 .28ni	.\$281.00
15" 1024x768 .28ni	.\$399.00
Mini Tower Case 250W 5 bays	\$99.00
Mid Tower Case 250W 6 bays	.\$149.00
Mouse Serial	. \$25.00
Keyboard 101 Enhanced	.\$49.00

Computerlane Inc.

Outside California: 1-800-526-3482

Inside California: 818-884-8644 • Fax: 818-884-8253

comlane@instanet.com

7500 Topanga Cyn Blvd., Canoga Park, CA 91303 Hours: Monday – Friday 9–6, Saturday 10–5 Compan is A Registered Trademark of Compan, IBI is A Registered Trademarl of International Business Machines. All Quoted Prices Reflect A 5% Cash Discount. VISA, Master-Card, Wire Transfer Also Accepted. Prices Subject to Change Without Notice

Academic Software

Microsoft Academic Partner

Microsoft Office Professional for windows 95 (with bookshelf)

\$165

MS WINDOWS NT WORKSTATION\$125	
MS windows NT Server\$399.00	
Ms Backoffice\$1174.00	
Ms SQL Server	
call for other Microsoft Academic Prices	ŝ



Your One Stop Component & Computer Source

Seagate

Performance

SCSI Hard

Drive Solutions

Hawk

130542 Fast SCSI-II, 1.05GB

130577 Fast SCSI-II, 2.1GB.

Floppy Disk

Drives

118957 Panasonic 1.2 MB 5.25

118922 Panasonic 1.44 MB 3.5 74392 Teac 3.5*/5.25* combo.

with 4-Disc Changer

· Selection button for each drive with indicator

6X Enhanced IDE CD-ROM Drive

· Power tray loading · Windows '95 compatible

Alpec Laser Pointer Pen

Optical Laser Mouse

clicking . Compatible with Microsoft® mouse

133284 Laser Mouse w/ optical pad.

· Also plays video, photo and audio CDs

PC/XT/AT compatible

Use with enhanced

IDE interface

600KB/sec. data

Cables not included

· Requires enhanced IDE

controller card

SoundBlaster

compatible

195ms access

• 200 yard range

• 670nm red laser

· Heavy duty

Three modes of

selected from a

combination of

clicking which

mode, sketch

facilitates mouse

operation that are

· Power requirements:

229ms seek time

256KB buffer memory

900KB/second transfer rate

133031 6X IDE CD-ROM drive

2 AAA batteries (included)

127749 Laser pointer - pen.

133508 4X 4-disc DC-ROM drive

transfer rate.

. Average seek, read/write: 9/10.5msec

. 3.5" low profile . One-year warranty

Average seek, read/write: 8/9msec
 3.5" low profile • One-year warranty

Average seek, read/write: 8/9mseq

1024KB multisegmented cache buffer
 3.5" low profile • One-year warranty

Barracuda 2LP

Barracuda

130593 Fast & fast wide SCSI-II, 4.2GB ...\$1199.95

NEC 4X IDE CD-ROM Drive

Products highlighted in yellow offer special pricing for BYTE readers only! Take advantage of these outstanding values by mentioning VIP NB6 when you call today to place your order.

Embedded 486 CPU Card for Panel PC Based System

For use with the passive back plane (P/N 133250) in industrial panel systems that use heavy duty chassis

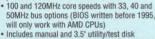


· Award BIOS

 Compatible with following 168-pin PGA socket CPUs: 486SX/DX/DX2/DX4/5x86 (not included) 133241 Embedded CPU card...

Power Leap Upgrade Adapter For 486SX/DX/DX2 to 586-100/120

- Supports 5V 486 motherboards only 586-XXX chip
- not included · Supports 64-bit
- X86 compatible processor with 16KB write-back cache



131941 Upgrade adapter for 586 CPU...

PCMCIA Type II Combo BNC/UTP Ethernet Card

 Minimum requirements IBM compatible PC with 386SX



socket, BNC/UTP Ethernet connectivity, PCMCIA release 2.1 compliant card services 10Mbps speed in 10BaseT and 10Base2 format

132581 PCMCIA network card.

Jameco Printer Card 2 Bi-directional Parallel Ports



- 286/386/486 & Pentium® systems (16-bit bus)
- Supports ECP/EPP/SPP
- Select from IRQs: 3, 4, 5, 7, 9, 10, 11, 12, 15
 Address selectable to LPT1-LPT6
- · Print mode jumper selectable
- 132214 2-port printer card.

\$39.95

Jameco High-Speed Serial Card 4 Serial Ports

PC/XT/AT and compatibles

Four serial

ports: two each DB9M and DB25M High-speed 16C550 **UARTs** with



16 byte FIFO • IRQs: 3, 4, 5, 7, 9, 10, 11, 12, 15

 Includes cables and instruction sheet 132572 4-port hi-speed serial card

Dynamic RAM

	311	MIMIZ		
Part No	.Product No.	Description	n	Price
53701	94000S-70	4MB x 9	70ns	\$59.95
53719	94000S-80	4MB x 9	80ns	54.95
75117	P361000-xx-7	1MB x 36	(4MB).	54.95
75096	P362000-xx-6	2MB x 36	(8MB).	99.95
75168	P364000-xx-7	4MB x 36	(16MB	159.95
41515	41256A9B-70	256KB x 9	70ns	9.95
41769	421000A9B-80	1MB x 9	80ns	20.95

ZYNK 17" SVGA "Green" Color Monitor

 PC/XT/AT, 386, 486, Pentium⁶ and compatible computers

0.28mm dot pitch

operation



Green monitor power management 133786 17" SVGA monitor.

Win '95 104-Key Keyboard w/ Trackball and Palm Rest



. Dual connectors: keyboard 5-pin DIN, and trackball 9-pin serial connection on one coiled cable

133760 Win '95 trackball keyboard ..

IBM 89-Key Adjustable Keyboard



- PS/AT style Adjustable keyboard with standard
- **QWERTY layout** Left and right set of cursor-movement keys Erase-ease feature
- 132978 IBM 89-key adjustable keyboard....\$44.95

QTRONIX. Sheet Feeding Scanner

256 true gray scale - full width - Windows® '95 compatible!



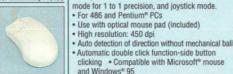
- 800 dpi x 800 dpi in gray mode
- . Minimum system requirements: IBM PC or compatible-386, DOS 3.3, Windows® 3.XX, 4MB RAM, 5MB hard drive space, one 16-bit ISA slot . Includes software and manuals: Twain, Presto!,
- wordlinx and Image ProImage Plus

133233 Paper feed gray scanner

Microsoft® 2-Button Mouse

- PC/XT/AT/ 386/486/ PS/2 and compatibles
- Includes Microsoft® setup diskette and manual

111860 2-button serial mouse



© 1996 Jameco 11/96

Ordering Hours: 5:30am - 5:30pm PST http://www.jameco.com

COMPLITED PRODUCTS

Call for your FREE catalog! 1355 Shoreway Road Belmont, CA 94002-4100 FAX: 1-800-237-6948 (Domestic) FAX: 415 • 592 • 2503 (International) E-mail: info@jameco.com

and Windows® 95



Call 1•800•831•4242 to order today!

Jameco 64-Bit VESA Graphics **Accelerator Card**



1MB expandable to 2MB

\$409.95

\$849.95

\$39.95

119.95

SPECIAL

- Non-interlaced resolution and Zero-FlickerTM refresh rates provide you with exceptional versatility and display clarity
- VESA-compliant 28-pin feature connector for multimedia applications
- Full VESA and VGA selectable modes

132935 VESA graphics card.

SPECOM Videoconferencing Card

With VisionTime Pro Software This package offers friendly and affordable, easy to use desktop personal videoconferencing. With a PC and a modem, you can do document conferencing. If you use a DSVD modem, you can do voice conferencing,



\$99.95

SPECIAL

33,600 bps data

- modem, 14,400/9600 fax modem Fully compatible with
- ITU-T V.42, V.42bis V.34, V.32bis, V32 V.22bis, V.21-23, MNP 2-5 and as

a fax/modem communicates with all ITU-T group 3 fax machines

129672 Internal 33.6 fax/modem

Modem Technical Guide The Modern

Technical Guide is great tool for beginners and experienced modem users and includes a bonus CD-ROM! The book starts off with a modem primer, then

gives you set-up information, hardware configuration settings and diagrams for many of the most

popular modem models on the market 133794 Modem Technical Guide

Switchbox for 4 Monitors This unit allow

you to duplicate a video signal from one source to 4 monitors up

Perfect for broadcast systems, conventions schools and multiple display uses!

Suitable for SVGA, VGA and multisync monitors

- · Daisy chainable
- · Power-save mode when computer is off, indicated by flashing power LED
- DB15 female connectors on box
- · Slide switch for video signal gain control Includes power adapter 9VDC @ 130mA

133866 Switchbox for 4 monitors ..

SL WABER Surge Protectors 330V clamping voltage

- · EMI/RFI noise reduction
- · Audible alarm · 3-line protection

SurgeSentry 6 Outlet

· Ultimate 3-stage protection . No limit connected equipment manufacturer quarantee

 62,525 amp spike suppression; 880 joules

133090 6-outlet, suppress 62,525 amp....



 Standard 1-stage protection

 \$1000 connected equipment manufacturer guarantee

 13,000 amp spike suppression; 520 joules 133081 7-outlet, suppress 13,000 amp.....\$12.95







\$139.95

\$49.95

- SATISFACTION GUARANTEED NO SURCHARGE ON CREDIT CARDS
- **EDUCATIONAL PRICING**

NOW FREE CATALOG!



Always your best buy on the widest selection of memory upgrades!

DESKTOP CO

COMPAO Plesario 425, 433, 633, 640, 660, 800C, 800E, 800E, 803, 830, 866 Prolines RM 4/35, MM 4/30, MM 4/66, 4/254, 4/234, 4/30, 4/66, 4/253, 4/86 4, 4/34, 4/36, 4 Presente 972 974 978 982 992 5526 5528 5536 9536 9546

5133, 5	5, 590					
4NB	172713	001	531	BMB	172713001_	556
16ME	17271	(001	\$114	32ME	172715001_	5220
TAB V	deo	171	017,001			\$49
256K 0	ache	223	557001			\$49
			2,7234			
					001	562
TAMB		236	548-001, 548-002,	2365137	001	\$108
			5228			\$456
					4/4	\$49
			0, 9250, 1			
					234566-001	\$108
					eVa	\$456
			922:001			\$40
					166 2000/WL 5	
					\$150.1200/2000	
					ML 5166 2000/	
840/12	00, 5120	1200, 5	133 1200	/2000, 5	5166 1200/2000	575 840
BMB	24301	1.001	562	16ME	243012 001	5108
32ME	2430T	3-001	5228	64MB	243014001	\$456
1M6 V	den	171	017-001			540
			335-001			5139
			336001			5369
	3E 560. 5					
				27147	140012-001	2424

				75NX, 590NX, 3	
				5100e, 5120e, 5	
5133, 575, 5		00, 450,	466, 575	MX, 590MX, 510	0, 5120,
4MB 17	2712-001	531	BMB	172713-001_	556
16ME 17	2714001	\$114	32ME	172715-001	5220
TMB Vicino	1210	017:001			\$49
256K Code	223	557001	100		\$49
Prescrip. 721	5 WASS THE	A 1999 F	22.40		
					\$62
TOME	236	\$48,002	236513-0	01	\$108
32MB n/	g	5226	6408	n/a	\$456
TMS Video	236	709-001			\$49
Preserio 9231					
BMB 22	4567-001	562	16MB	234566-001	\$108
32MB n/	0	3228	64MB	n/a	\$456
TMB Video	213	722-001			\$40
Prolines 513	3 2000/ML	5150,200	05/ML 51	66 2000/ML 51	00
				150 1200/2000	
				WL 5166 2000/8	
				186 1200/2000	
				243012-001	
				243014001	
THE WAR	222	235.001			4110
KNID 16-5	920	222-001		111 111	0445
	60, 5766AA, S				2001
			77145	149912-001	2422
				149914-001	
	139				549
Deskpro XI 4	50, 466, 560	,566,51	00, 5120,	5133, 575, 590	10
BM8 14	#B186-001	574	TOME	148189-001	5142
					549
				00 2100/PD	
16MB 2	10948-001	5481	32M6	228417-001	\$375
64MB	228	418001.			\$851
2M8 Video	223	335-001			5139
6M8 Video	223	336-001		1.100	\$369
Designo XE 4	100, 431s, 4	50, 466			
AMB 1	11684001	545	EASE	141685-001	582
IMB Video	139	167-001		102	\$49
256K Code	194	358-001,	1943580	102	\$49
Backren 3/2	1/33/38	AJ25M T	BACTIAN	4/25/5 A/201 A	U/AA-

			1	la .	
Forwar De	sktop 456 Modi	di:			
4MS	3102507	\$37	16MB	310-2625	5127
PowerEdg	e XE, Optifies,	Dinemion 3	PS. Onn	Plax ME 466 & Perk	ormonce
M/L/TM	odels				
4MB	3103325	531	BMB.	3106083	556
16MB	310-3327	5114	32ME	N/a	5220
Performa	nce ME, Ownitte	n Feedum A	AE, Opia	lex DGX, FowerEdge	
SP/NE/E	Models		-		
EME	3103335	564	TOMS	310-3336	\$128
32MB	310-3337	\$260	64MB	11/0	\$462
Powerlin	Workstations S	E & DE Mod	dels		
BMB	3102468	574	1646	310.2469	\$142
32MB	3102630	5254			
Diesersio	n XPS & OptiFloo	XL/XXX/XX	AT Pontium	Models .	
8MB	310-2647	564	16Mb	310-3374	\$128
32MB	3103375	3260	54MB	310-3368	5462
	P	VE	=	_	
	de & Ready 486	Models			
4MB	158 082222	000 \$37	1608	158-082222-000	\$127
	m 486 D/M Mc				
				OP-410-4004	
TAME.	OP410-4005	\$114	32MB	OP4104006	\$220

C/AI	W 14 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2	182.00	
"You'r	er got a friend i	n the business."*	
& Funly PC P.	5 Series Modeli		
n/n		SMB ^{IIII} N/o	551

CATEUN 2000

AST

	Q	MPL	TEP		
Brovo IC	& MS Pention Mc	odels			
BMB-	503008-001	\$62	16ME*	503008-002	\$108
32MB**	503008-003	\$728	64M8*	503008-004	\$456
Monhatto	n V & G Models I	hemeio 4	/33, 4/3	31, 4/508, 4/666	L MITE
4/33, 4/	66d, P/60, SE 4,	/33, SE 4/	66d, SE	P/60	
8845	501159-002	574	ToMB	501159-003	\$142
32MIL	501159-004	\$254	6446	501159-005	\$494
Brown LP,	MT, IC (# & IC (II, Prenn	is MX &	IX & Advantage I	Aodels
ZME.	500987002	531	BMB	500987-003	\$63
I SMB	500987004	5114	32MB	500987-005	5228
Bravo 4/	33 (orginal), 4/25	, Premium,	IE, Franc	ion II,	
1	mium Models 500780-004	567	BMB.	500780-001	592

NEW LOWER PRICES!!

		il modelų 8					
۴		92G753					
	16MB	92G754	3	\$114	32M8	92G7545	\$220
	TMB VI	des	92G7	443			549
	256K C	ache	9207	251			\$79
	Volunificia	e 6384/64	72/648	2/6484	/6492/6	494/6381 S-M	ndels
	4Mb	92G313	1	137	BMB	92G0130	17
	1666	920016	0	\$127	32Mb	9200320	5340
	PS/Volum	Point 6384	PS/T C	onsilan	t/Essentio	/Expert Models	
	4MB	96F9290)	\$55	1646	96F9291	\$146
	PS/Volum	Point 6382	/6384/6	387, P.	7		
	Advisor/	Consiliant/	Essential,	/Expert/	Willow/In	nvestor Models	
	AMB .	645012		\$37	BM8	6450130	
	1648	92G720	4	\$137			
	PC 700	Model 750	/6887, N	Model 73	0/6877		
	BMB	92G731	88	\$63	16MB	92G7320	\$13
	32M6	92G732	2	9236	641/8	92G7324	\$450
	PC 700	Model 750	/6885/6	886, M	odel 730)	6875/6876	
	4NB	73G313	1	\$37	BMB	6450130	
	16MB	92G720	4	8127	32NB	92G7205	134
	PS/2 25	/286, 30/	286, 353	SX/LS, &	05X, 50Z	.5550/15, 655	(AS, 70,
	80, 900	P. 95XP.					
	2MB		30E53	360, 643	50604, 6	450608, 64503	79\$3
	4MB		34F25	233, 679	9977, 6	151060	63
	EMB.		6450	129	Nour s	SW-V/	57
	Espansio	er Boards fo	175/23	ystems.			
ı	416M	w/4M6	6450	609			\$10
ı	2146	8 w/2M8	34F30	577			\$10
ı	4100		4,000	SV I			414



4MB	D2974A	\$37	BMB	D2975A	\$71
TAME	D2676A	\$127	32MB	D2298A	5247
Vecto XI	I/XM3/XM2/M	2/N2/VL3/	VE, Multi	redia PC & Povi	lian Models
ANB.	D2690A	531	BMB.	D2691A	\$50
TOMB	n/e	5114	32MB	n/a	9220
Vecto 45	16 XM/ST/U/T/	N/M/NE/M	I/VI Mod	leb	
4MB	D2156A	\$37	BMB	D2152A	571
16M5	D2676A	\$127			

diqital

	THE REAL PROPERTY AND ADDRESS OF			
4MB	TE, IP & MT Models FEPC74MAA 537	1608	FEPC74MAB	\$127
	Ventoris Models FEPCVAMAA	BMS	FEPCVAMAII	558
16MB	FRECVAMAC\$114	32MB	FEPCVAMAD_	\$220

MICRON

41/85	n/o	529	BMB	n/a	\$50
TAMB	1/0	5108	32MB	n/a	520
PCI Meller	nnia Series, Pa	www.Station.S	oriei & No	ma MPC Sar	ian Models
4NB ^{mb}	n/o	529	SME ^(x)	n/a	55
TAMPING	n/a	5104	32M8FF	non	\$19

Packard Bell.

_					
Esecutive	Series, Foro	Series & Liego	nd Section	Modele	
448	1/0	529	BMB	n/o	553
16MB				n/a	5209

UPGRADES UPGRADES D

30-P	IN
1 x 3-70ns (3-chip/1MB)	\$10
1 x 9-70ns	C 9 79
4 x 3-70ns	^{\$} 17
(3-dip/4MB)	527
4 x 9-70ns	\$36

)ns	Non-parity	Purity 1 x 36-70	1 x 32-60	DRAN
B)510	(4M8) \$22	(4MB) 528	(4MB) 524	168-PIN
s 17	2 x 32-70 (8M8) 542	2 x 36-70 (BMB) 556	2 x 32-60 (8MB) \$47	8MB
Ons 527	4 x 32-70 (16MB) \$90	4 x 36-70 (16M8) \$105	4 x 32-60 (16M8) \$99	16MB
Ons \$36	8 x 32-70 (32M8) 5184	8 x 36-70 (32M8)S204	8 x 32-60 (32MB) 5198	First Source Intern Always Includ Installation Instru (on standard si
ALW	AYS CAL	L FSI BEF	ORE YOU	BUY!

72-PIN



EDO				
1 x 32-60 (4MB)	524			
2 x 32-60 (8MB)	547			
4 x 32-60 (16MB)	599			
8 x 32-60	Commence of			

A	Synch DR 16	ronous AM 8-PIN
*	8MB	\$95
7	16MB	\$155
9	32MB	5382
8	Always	International Includes Instructional

5198 Installation Instruc-(on standard simi

4	HEWLETT PACKARD
49	PACKARD

W Cart.	227078			539
4				
	C2024A			. 52
C3148A	564	BMB P	8/4	\$100
AM, ASA	AX, AS, Deskle	1200C	1200C/PS, D.	ssignaler Series
C3148A	56	EMB 1	C2066A	57
5, 4+, 41	4WV, 4M+, 4	P. 4MP, 5	2. SWP, 59, 59	iaWX, Color
Seak Just 1:66	OC, 1600CM	Copylet		
			C3133A	50
C3146A	\$119	9		
E 187+, 1E, 1	KD, NP			
a Brd.	H334758			
s. Bed.	1/0			-5129
80				
p. Brd.	HG34448			\$7
. Red.	H334458		_	512
	W Cort. 1, 9.85 C3148A 4M, 45M C3148A 55, 4e, 4M C3132A C3146A C3132A C3146A C3132A C3146A C3132A C3146A C3132A C3146A C3132A C3146A	MY Cort 227078 C2024A , S45 C3148A 564 4M, 45M3, 45, Denkla 565, 4e, 4M, 4M4, 456 53, 4e, 4M, 4M4, 4M4, 4M4, 4M4, 4M4, 4M4,	C2024A	M. Cort. 27079. C 20024A. 1, 9.55. \$69 Bill. of a. C 1448A. \$61 Bill. of a. Bil

139167-001 LOWER -PRICING!

1Mb Video

LOWER PRICING!

AST

Perigro 3/25i, 3/33i, 386/23M, 386/33M, 4/25i5, 4/33l, 4/66i

486/33IX 485/50M, 486/66M, 485/16M, 486/23IX, 485/33IX 4MB 18690001 \$45 BMB 128877.001 \$83 512K Video 141235.001 \$39

Ascentia 800N & 810N 4M6 S01488-001 16M8 S01488-003	\$79		501488-002	\$114 \$209
Ascentis 900N & 910N ; 4M6 501392-001 ; 16M8 501392-003 ;	569	BM8	501392-002	5100 \$191
Ascentia 950N Models BMB 501728-002. Ascentes I Models	5104	1608	501728-003	5189
8M6 501984001. 32M8 501986-001.	\$87	16MB	501985-001	\$159 5389
Ascentin P Models 8M6 501013-001 22M8 501013-003	5102	16ME	501013-002	\$269 CALL

COMPAO

	Aero Models 190532-001	£ 8 81	nier.	imentoni	599
	190598-001		INAD	(4004)-(1)	\$219
			*		3217
	4/25, 4/25CX, 4				
	146520 001		BMB.	146521-001	\$117
	1146531-001				\$151
	400, 410, 420, 4				
AMB	147653-001	550	EMB	147655-001	5111
15MB	147657-001				\$199
Concerio	4/25, 4/33 Mod	lels .			
	144790-001		\$340.	144790.002	\$109
	144790.003		Contract of	(44)	\$219
	486 Models				
	199013-001	446	OUR	100011-001	\$109
	199017-001		oma	199013001	\$174
					2174
	ism 5000 Models		avera!		2000
	213515-001				\$163
	213515-003		SAME	213515-004	5624
Amodo	4110, 4120, 413	0			
BMB	217914001	5107	TAME	217915-001	5229
32MB	217916-001				\$409
Armodo					
PETERSON	C TANK		A 160m	S and the State of	2000

Apple Computer PowerBook S20 & S40 Mudels 8M8 M1913IL/A. ____\$109 16MB n/s.

T- OFFICE	A chime and an	4100	7504	Cover	
BMB	M37508/A		TOME		\$199
24WE	n/o	5269	22MB	6/0	\$349
		-			
	- 1		4		
W. San				-0.	
	133 Models				
4MB	3103385	569	TOMS:	310-3386	\$219
Softude 4	t33m/mc, 450mc	/nox, 475	m; 13.4	100/475 Models	
AMB.	3103416	\$89	SMB	n/a	\$139
16MB	3103417				5239
Smilude X	P 450/475/410	O, XFs Penil	um Mode	di:	
448	310-3421	559	BMS	3103435	589
	310.3422				\$162

digital

AMB.	FEPCETMAA	\$50	DAME	TENTETIAN.	400
-	FRECETMAC_	447	. Introd	TREAT MINE	5162
HiNole I	lito 486 & Litro \$1	Feetium N	debo		
4MB	FRPCFBM.AA.	559	BMB	FRPCPBMAB	589
TOMB	FRACESMAC				5162
HiNoto V	F Festive Models				
BMB	FRPCP9MAA	5109	16ME	FEPCP9MAB	5269

CALL FSI WITH THE NAME OF YOUR PC!

Our upgrade experts have detailed configuration information on thousands of computers and printers, from the oldest to the latest models!

WE PROVIDE YOU WITH: Your system memory features (RAM, cache & video)

How much memory you really need Memory products available for your system Most cost effective upgrade path for your system memory capabilities

TEXAS INSTRUMENTS

TravelMo 4ME	% 4000M Models 9793357				\$139
Extense 4	150 & 455 Models				
4MB	9803932 0001	559	BMS.	9803933-0001 _	\$109
1648	9804002-0001.				\$399
Extenso 5	10 & 515 Models				
SM5 ^{im}	9805763-0001	\$109	16MB ^{ro}	9805763-0002	\$201
Externs 5	50, 555, 560, 57	0 Models			
8ME	9809810 0001	\$99	16MB	7804841-0001	\$191
	te 5000, 5010, 50				
BME	9798816-0001	5179	16MB	9798816-0002	\$299
TravelMa	te 6020, 6030 Mo	dels			
BME	9811456-0001	CALL	TAMB	9811456-0002	CALL

TRM

		-	=1=		
Thirkfoo	350 Models				
446	79F1000	559	BMB.	07G1828	599
1646	60G0379				\$128
				5 Pentum Models	
448	84G5689	569	BMB	84G8697	\$90
				1/0	
ThirkFoo	365 C/CS/CD	CSD & 365	E/ED M	lodels.	
4MB	92G72B7	550	TOMB	92G7293	5209
Thinkfool	365 X/XD & 56	ió Modele			
BMB	9207340	\$109	1646	92G7341	\$219
ThinkPod	500 & 510 Mo	dels			
41/6	8189098	560	BMB	8189099	\$119
TOMB	8189113				\$279
Thinkfood	701 Models				
4MB	92G7259	552	BMB	92G7261	592
1546	92G7263				\$186
ThirdPad	750, 755 486	Models			
AME	07G1420				599
BM6	07G142T				5169
16ME	86G5109				\$219
ThirkPod	760C/CD/L/LD	Festion Mo	odels.		
BM6	92G7315				\$99
16M8	92G7316				\$179
ThirdPod	760E/ED/EL/EL	D Festion A	Aodela		
BMB	9207240				\$100

		- 11	JO	āЩ	BA	
	T1900, T	1910, 11950, 11	960, T4500	, T4600,	T4700, T4800,T48	50, 1490
590	4MB	PCPA2012U	\$59	SMB	PCPA2013U	\$108
\$128	T6MB	PC#A2014U		3275		\$198
-9146	14400 N	Nodels				
11000	AMB	PCPA2004U	579	8443	PCPA2005U	\$109
\$90	16M8	PCPA2010U		100		\$189
5389	T2100.1	2105, 12110, T	1115, 1215	0. 12155	Models	
	4M6	NW2026U	549		NW2027U	587
5209	1,0448	NW2028U				\$139
	T100, T1	05, 1110, 7115.	1400, T40	5, 1410.	T415, T420, T425,	1610.
\$210	Tecro 71	0/720 Models				
3219	BMB	NW2001U	5109	16MB	NW2032U	\$179
	32MB	NW2034U				\$299
\$119	Sicra 50	O Models & Porte	us 650CT			
5279	BMB	FA2038U	\$136	1648	PA2039U	\$274
	32ME	PA2040U	5473	48ME	PA2041U	5740
505	Tecro 70	O Models				
-	SMB	NW20350	5129	1648	NW2036U	\$219
5186	32MB	NW2037U		111000		\$529
599			NI	=		
5169	40.00	500, 550, 2000	1000			
\$219		OF-410-1201			OF410-1202	504
		OP410-1201		anya	OF410-1202	\$167
too		M. P. 4000, 405		Alb.		1114101
		OF4104001			OF410-4002	5114
5179		OF4104001.				\$351
		00 Models	1000	44/60	CE-410-4004	
\$109		OP-410-62001	\$120	LANE	OF410-62002	\$229
\$199		OP41062001		inet	DE-HIUGDAY.	5465
4138	52W0	UF 410 02003				4403

IF YOU CAN'T FIND WHAT YOU'RE LOOKING FOR CALL!

MAIL OR FAX ORDERS TO:

(714) 448-7750 • FAX: (714) 448-7760 EMAIL ADDRESS: soles@firstsource.com First Source International 7 Journey * Aliso Viejo, California 92656

FSI SALES HOURS Monday - Friday: 6am - 6pm Saturday, 7am - 4pm

TECH. SUPPORT HOURS Monday - Friday • 7am - 5pm Technical Support: (714) 448-7770 All hours Pacific Standard Time

the Upgrade Experts

International Orders Call 714-448-7750 SEE US ON THE INTERNET: www.firstsource.com









THEMS & CONDITIONS: (melt card ondes shipped only to year verified fishing address, M interns must be to hand new condition, including oil original packaging, warranty cards, manuals and occasions and may be solvent to a 20% restocking feet. All returns and exchanges must be made writing. It is days of invent don. It is cares; internal non-conquient, patters, scanners, memory and software for separat or replacement one; Suppar quit insurance durages we non-relandable. A Rotion Monthable Authorization (CDAI) number is required to all situates, please contact our cart memory and a superior commission. Manuary patterns, to a feet of a situate, please contact our cart memory and a situate of the control of



Take the quickest route to healthcare Information Systems solutions

n today's dynamic healthcare climate, decisionmakers can't afford to get lost while searching for the right Information Systems solution.

MDB Information Services-an alliance with Datapro Information Services Group and MDB Information Network-delivers the break you've been looking for. We're the only worldwide, comprehensive provider of immediate, actionable data for purchasing Administrative Systems, Clinical Support Systems, Client Server Technology, and Network Integration.

MDB Information Network members annually save more than two to three times their membership cost to MDB Information Services by relying on MDB's up-to-the-minute acquisition and analysis of information on hundreds of Information Systems products and services.

Plus Added Value

MDB Information Services also delivers:

- · Information technology briefings/strategic planning
- · Custom RFP electronic templates to speed response
- · Cost-benefit analysis of systems and technologies
- · Success Matrix to measure process improvement
- · Access to Consultation Center and on-line services

Call 1-800-687-0001

Administrative Systems

General Financials to Utilization Management, Ancillaries including Home Health and Long-term Care.

Clinical Support Systems

ER, Laboratory, Pharmacy, Radiology, Physician Management Systems, Clinical Pathways, and more.

Client Server Technology

From Workstations to Telemanagement, Scheduling to Network Management.

Network Integration

Network Operating Systems to Community Health Information and beyond.



MDB INFORMATION SERVICES

An alliance with Datapro Information Services Group, Andersen Consulting, and MDB Information Network

DATAPRO

We Carry

BASF brother. Canon

CENTRONICS

CITIZEN' CCATA CREATIVE LABS INC.

CLIRTIS Dataproducts dodd Dysan

EPSON' EXABYTE FACIT W FUITSU

GRAHAM MAGNETICS GENICOM

PACKARD IBM (-)MEGAT OR KYDCERA M. TALLY

maxell MICROSOFT

Mashua NEC OCLI OKIDATA olivetti OLYMPIA

OTC PACIFIC DATA

Panasonic

=Polaroid GMS Oune. RIGOU

Seagate

SEIKOSHA CORONA SONY. STOP

SYQUEST &TDK TEAC Tektronix

INSTRUMENTS TOSHIBA

TRIPPLITE

Verbatim WANG and many more

OEM supplies!

ALL LOGOS ARE THE PROPERTY OF THEIR

RESPECTIVE COMPANIES

HIGH-CLIP PREFORMATTED MF2HD 3.5" HD 1.44MB DISKS 10 PER BOX...\$3.00

LOWEST PRICES

Prices in US \$ from America's Leading Exporter

3.75

3.75

DISKETTES (10 PER BOX) DESCRIPTION TDK BASE MAXELL SONY DS/DD 3.15 3.15 3.25 2.00 3.45 4.45 51/4" DS/HD 3.25 2.50

3.75 3.75

DS/HDF 3.65 3.35 3.65 BROTHER

DS/DD

DRUM UNIT 630/641/655/665127.95 TONER CARTRIDGE 630/641/655 . . . 24.95 FAX CARTRIDGE 900 PC-9120.95 FAX PRINT CARTRIDGE PC-101 28.95

DATA CARTRIDGES

DESCRIPTION 3M MAXELL SONY 9.30 DC-6250 12.50 12.30 12.30 DC-6525 16.50 16.30 16.30

OKIDATA

RIBBONS 400/800 TONER ...17.95 320/321/1005.25 400/800 DRUM . . .169.00 380/390/3915.95 400E/810E TONER .16.95 520/5217.95 400E/810E DRUM 117.00 590/5917.95

4MM & 8MM CARTRIDGES

DESCRIPTION TDK SONY EXABYTE 4MM 60 METER 4.50 5.15 4MM 90 METER 4.75 5.35 8 50 8MM 112 METER 4.75 5.25 7.50

OPTICAL DISKS

DESCRIPTION 3.5" 512/230 MB 23.95 25.95 13.50 5.25" 600/650 MB 44 95 40.95 39.50 5.25" 1.2/1.3 GB 47.95

HEWLETT PACKARD

TRANSPARENCY/PAPER HP51604A ... 8.50 HP51630Z .. 15.75 HP51625A ... 22.50 HP51630S .. 45.75 HP51626A ... 20.95 HPC3835A . 37.75 HP51629A ... 21.50 HP92281K .. 52.75 HP51649A ... 23.50 HP17703T .. 35.75

LASER TONERS RIBBONS HPC3900A ... 123.95 HP92151H ... 4.25 HPC3903A ... 67.95 HP92155A ... 11.75 HP92291A .. 102.95 HP92155L .. 13.95 HP92295A ... 59.95 HP92156S ... 8.45 HP92298A ... 86.95 HP92154B . 109.00 We carry a complete line of HP Products. Please call for the lowest prices.

PANASONIC

KX-P115 RIBBON6.99 KX-P155 RIBBON6.99 KX-P4450 TONER KIT 28.69 KX-P4450 DRUM KIT115.69 (CALL FOR OTHER PANASONIC ITEMS)

OPC KIT 80/81/150125.95 FAX TONER SM300059.95 FAX TONER SM100018.95 CD-R 74 MIN 650MB6.75

KYOCERA

DEVELOPER 117.00

LN03X-AC TONER KIT 36.75 LNO3X-AD OPC KIT 136.00 TK-50 TAPE CARTRIDGE 14.95 TK-70 TAPE CARTRIDGE 23.95 TK-85 TAPE CARTRIDGE 34.95 TK-88 TAPE CARTRIDGE 93.95 Dec Ribbons & other supplies Please call for the lowest prices.

IOMEGA (Bernoulli Cart)

51/4" GOLD 150 MB 79.95

SYQUEST (Removable Disk Cart)

44 MB 56.95

BC-01 INK CARTRIDGE17.50 BC-02 INK CARTRIDGE18.50 FX-1 FAX TONER64.50 FX-2 TONER HP C-3900A ...119.50 EPS/SX TONER HP 92295A54.50 TONER HP 92275A61.50

TEKTRONIX (Phaser III supplies)

016-1123-00 COLOR STIX BLACK 130.00 016-1124-00 COLOR STIX CYAN 75.00 016-1125-00 COLOR STIX MAGENTA .. 75.00 016-1128-00 COLOR STIX YELLOW 75.00 016-1144-00 CLEANING KIT 30.50 016-1103-00 TRANSPARENCY SHEETS 125.00 016-1219-00 TRANSPARENCY FILM .. 125.00

(CALL FOR OTHER TEKTRONIX ITEMS)

EPSON

RIBBONS 7753 3.45 SO50002 .. 107.95 7754 3.85 SO51005 ... 137.95 7762 5.85 SO51009 ...177.95 8750 3.05 SO51011 ...147.95 8755 3.45 SO51023 ...107.95 8762 5.85 INK JETS 8763 4.25 SO20002 17.95 8764 9.05 SO20025 9.15 8766 17.75 SO20034 11.45 8767 11.45 SO20036 23.45 COPIER TONERS

CANON F41-2302-100 75.00 F41-4102-710 100.00 F41-4214-700 89.00 CANON COLOR F41-6811-000 83.00 F41-6821-000 83.00 F41-6801-000 83.00 946-181 9.25 946-241 12.25 947-376 MINOLTA 8915-743 12.90 8915-348 27.90 8931-202 76.90 MITA 37037011 12.25 37041011 5.25 37042011 27.25 RICOH 887051 5.75 887132 6.75 SHARP SF-730MTI 16.50 SF-830MTI 14.50 SF-980MTI 33.50 TOSHIBA T-220P 22.50 T-61P 10.50 XEROX 6R-229 27.90 6R-244 51.90

RIBBONS 1040150 8.20 1382100 ...135.00 1040282 ... 45.30 1382150 ...175.00 1040440 ... 11.40 1380850 ...145.00 1040930 7.50 1380950 ...170.00 1299095 1.80 1380200 ... 143.00 1299790 9.90 1380520 ... 160.00 1299845 3.90 1669113 17.00 1299933 ... 13.80 1669115 60.00 1319308 ... 11.30 1669151 60.00 1337765 2.70 70X7001 ... 72.00 1361195 1.60 70X7002 .. 175.00 1380999 3.40 70X7003 ... 17.00 6295158 ... 28.40 70X7280 ... 34.00 6328829 5.30 70X7281 .. 124.00 6845100 ... 28.90 70X7243 .. 363.00 7034437 ... 27.50 70X7244 .. 276.00 7034640 5.60 70X7285 ... 85.00

6R-257 41.90

RECORDABLE CD'S

7819690 ... 12.80 70X7286 .. 384.00

CD-R 74 MIN CALL KODAK CD-R 74 MIN CALL MAXELL MITSUI CD-R 74 MIN CALL PHILIPS CD-R 74 MIN CALL CD-R 74 MIN CALL SONY TDK VERBATIM CD-R 74 MIN CALL (PRICES SUBJECT TO AVAILABILITY)



5575 Magnatron Blvd., Suite G San Diego, CA 92111 USA

TEL: 619-278-2600 FAX: 619-278-2780

EXPORT SPECIALISTS

TERMS: WIRE TRANSFER (T/T) L/C at sight L/C at 90 days

Prices are subject to change without notice. We cannot be responsible for typographical errors.

New public network market

New competition

New technologies

New purchase influencers

New opportunities

New informational needs

New products and services

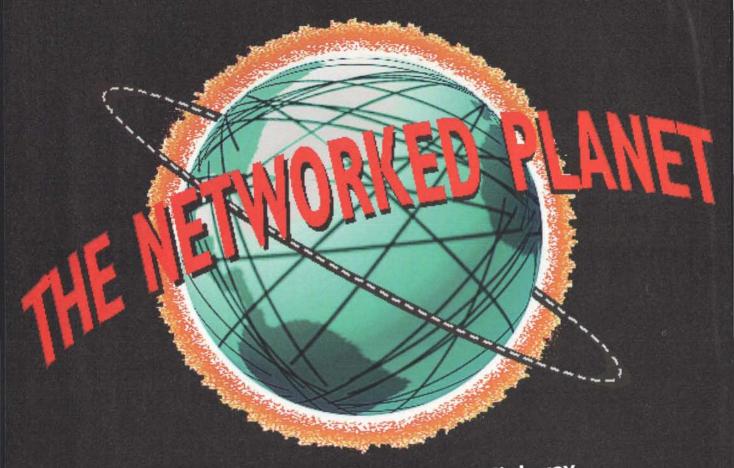
A new publication from

The McGraw-Hill Companies

For advertising information contact: Dan Daly, Associate Publisher (212) 512-6658

tele.com

A playground for experts. Training wheels for their friends.



Traveling the Information Highway

A new exhibit at

The Computer Museum

computer_info@tcm.org / 617. 423. 6758 / www.net.org 300 Congress Street, Boston, Massachusetts 02210

Principal Sponsor: Sprint

Major Sponsors: Apple Computer, Hewlett Packard, Novell, NYNEX, Stratus, S.W.I.F.T.



Official Media Sponsor ATTENTION INTERNET USERS

Call Global. Pay Local. International Calls from 10¢ a minute*.

(save up to 95% to any country in the world)

- · FREE software from our website
- · FREE trial to any toll-free number
- The first service which allows you to call any phone in the world from your PC
- No setup charges
 Cellular Quality

RATES FROM THE	U.S. TO
CANADA	13€
SWEDEN	17€
U.K.	18¢
AUSTRALIA	20€
GERMANY	26€
SINGAPORE	26€
JAPAN	29€

Visit our website for complete details and download our <u>free</u> software:

http://www.net2phone.com

Call us toll-free using Net2Phone at 1-800-438-8879 Or call direct at 201-928-2990. E-mail us at: info@net2phone.com



Putting global calling within everyone's reach.

Net2Phone requires caller only to have multimedia PC with any PPP Internet connection Receiving party gets call on regular phone. *15¢ peak. 10¢ off peak. Rates to the U.S.

NET2PHONE IS A TRADEMARK OF IDT CORPORATION





To get a peek at the first industrial handheld with the power of the Pentium® processor, come to booth H9 in the Microsoft Partner Pavilion at COMDEX.

Visit us and see the new Tek-Field, the first industrial bandheld computer that puts the power of the Pentium processor in the palm of your hand. It's a rugged, fully-contained unit, making it ideal for mobile applications of any kind. Features include a built-in Sound Blaster®, 6 PCMCIA expansion slots, dual mouse, 6.4" Active Matrix Color VGA monitor, touch screen, full I/O capability, and a Duracell® smart battery. Tek-Field is just one of the products available from

Teknor Industrial Computers, Inc. for OEM applications and industrial systems integrators. For more information, call us at 1-800-387-4222, visit our web page at http://www.teknor.com, or see us at COMDEX.

TEKNOR INDUSTRIAL COMPUTERS INC.

Trademarks are the property of their respective companies. The Intel Inside lovo and Pentium are registered trademarks of Intel Corporation

It could be a best seller.



You can't buy the Consumer Information Catalog anywhere. But you can send for it, free! It's your guide to more than 200 free or low-cost government publications about getting federal benefits, finding jobs, staying healthy, buying a home, educating your children, saving and investing, and more.

Send today for your latest free Consumer Information Catalog. The Catalog is free. The information is priceless. Send your name and address to:

Consumer Information Center Department BEST, Pueblo, Colorado 81009

A public service of this publication and the Consumer Information Center of the U.S. General Services Administration

Making these two environments work together has been like mixing oil and water...



...until nov

announcing

OPENIT for WINDOWS NT

Softway Systems, Inc.

185 Berry Street, Suite 5514, San Francisco, CA, USA, 94107 Tel: 415-896-0708 • Toll Free: 800-438-8649 • Fax: 415-896-0709 Email: sales@softway.com • WWW: http://www.softway.com/OpenNT

OPENNT, from Softway Systems, is the first product to provide true POSIX.1 and POSIX.2 conformance for the Microsoft Windows NT operating system. By providing an enhanced POSIX.1 sub-system and a complete set of POSIX.2 utilities and shell, NT users are finally given a 100% POSIX conforming environment. The same POSIX environment that most UNIX systems use but without sacrificing your investment in Windows NT. The same POSIX environment required by the U.S. Government for all operating system purchases as specified by FIPS 151-2 & FIPS 189. Conformance means file links, case sensitive file names, user and group ownership, background processing and more. Add to this a real POSIX shell and all your favorite UNIX utilities (like find, grep, awk, sed, 1s) and you end up with an environment so close to UNIX that you won't know it isn't UNIX!

OPENNT is available today. OPENNT Commands and Utilities is only \$199 - and we include free updates for a year.

Our 30-day money back guarantee and free technical support makes this a no risk opportunity to give your Windows NT system the POSIX punch it needs!

OPENIT is a trademark of Softway Systems, Inc. This product includes software developed by the University of California, Berkeley and its contributors. All other registered trademarks and trademarks are the property of their respective owners.

Raidtec RAII

Discover the best RAID price/performance in the industry. Raidtec is the affordable, open, SCSI-to-SCSI hardware RAID solution for complete data protection. Ideal for mission critical applications, document imaging & multimedia.

It's time to re-visit the ultimate in high-availability storage. Contact Raidtec today at (770) 664-6066.

- Fast, Wide, Ultra SCSI
- Programmable RAID Level selection: 0, 1, 10, 3/5
- On-the-fly hardware parity generation eliminates read, modify, write-back performance overhead
- Single ended or differential
- Downloadable flash firmware
- Rackable, stackable

- Remote alarms, configuration & monitoring
- **Environmental sensor ports**
- Hot replaceable drive bays, fans & power supplies
- New EAM & Service Channel
- Single SCSI ID
- Solid state-of-the-art load sharing power subsystem
- LCD control panel status display

THE STANDARD IN ADVANCED MASS STORAGE SYSTEMS

Raidtec USA 105 Hembree Park Dr. * Suite C Roswell, GA 30076, USA Tel.: (770) 664-6066 FAX: (770) 664-6166 http://www.raidtec.com

Raidtec EUROPE Glen Mervyn House • Glanmire Cork, Ireland Tel.: (353) 21-821454 FAX: (353) 21-821654

in Raidtec-Fibre Channel technology at COMDEX #\$3366

Gerry Westerhof Phone: 31 72 509 1855 Fax: 31 72 509 1145

Bulgaria

Daniel Christov Phone/Fax: 359 2 974 3557

France

Eric Le Quinio Phone: 33 1 49 77 03 06 Fax: 33 1 43 76 74 29

Germany. Austria. Switzerland

Wolfgang Brezina Phone: 49 89 525 847 Fax: 49 89 529 850

Greece

Maria Hadjioannou Phone: 30 61 620384 Fax: 30 61 272072

Hungary

Imre Szabo Phone: 36 76 488888 Fax: 36 76 488889

Ireland

lan Bangham Phone: 353 1 280 7133 Fax: 353 1 280 7157

Enrico Campia Phone: 39 11 8127656 Fax: 39 11 8994422

8/96

To Subscribe to BYTE magazine, or for Customer Service, contact your local BYTE **Subscription Representative:**

Middle East

Zafar Inamdar Phone: 971 4 666788 Fax: 971 4 621149

Wlodek Bincyzk Phone/Fax: 48 2 625 2275

Portugal

Manuel Neves Phone: 351 1 3479301 Fax: 351 1 3475127

Scandinavia

Gunnar Sandbjerg Phone: 45 3314 2226 Fax: 45 3314 2218 or Lauge Dehn Phone: 45 86 223188 Fax: 45 86 228159

South Africa

Cane Town: | Trisos Phone: 27 21 24 4094 Fax: 27 21 24 8681 Durban: T Tyson Tel: 27 31 2027303 Fax: 27 31 2027307 Johannesburg: M Kendrick Tel: 27 11 8804988 Fax: 27 11 4428327

Spain

Barcelona: Javier Casellas Phone/Fax: 34 3 2380342 Madrid: Eduardo Montojo Phone/Fax: 34 1 5716685 or Henri Misrahi Phone: 34 1 7337346 Fax: 34 1 7338970

Turkey

Cengiz Eren Phone 90 216 345 3473 Fax: 90 216 346 2464

United Kingdom

Peter Gregson Phone: 44 1 61 430 3423 Fax: 44 1 61 494 6976 or John Luker Phone: 44 1 258 821114 Fax: 44 1 258 821115

If there is no BYTE representative listed above for your country, please contact::

BYTE Subscriber Services

PO Box 72, Galway, Ireland Fax: +1 353 91 752793. Phone: +1 353 91 752792.

A Division of The McGraw-Hill Companies

A Message to Our Subscribers

From time to time we make the BYTE subscriber list available to other companies whose products or services would be of interest to our readers. We take great care to screen these companies, choosing only those who are reputable. Furthermore, subscriber names are made available for direct mail purposes only; telemarketing calls are strictly prohibited.

Many BYTE subscribers appreciate this carefully managed program, and look forward to receiving information of interest to them via the mail. While we believe this information is of benefit to our subscribers, we firmly respect the wishes of any subscriber who does not want to receive promotional literature. Should you wish to restrict the use of your name, please send your request (including your magazine mailing label, name, address, and subscription account number) to:



BYTE Magazine Subscriber Services PO Box 555, Hightstown, NJ 08520

A Division of The McGraw-Hill Companies

SOMETHING MISSING?

Complete your BYTE collection by ordering Back Issues today!

							,	9
	1991	1992	1993	1994	1995	1996	E Check e	nclosed
January							VISA	MasterCard
February							Card #	
March				1978				
April							Exp. Date	
May							Name	
June							Signature	
July								
August							First Name	
September								
October							Last Name	
November							Address	
December						188	Address	
Special Issues	Outlook '92		Windows '93 Guide Summer '93 B Guide Fall '93				City	
Special Issues U.S. Delivery	\$3.00, Foreign De	elivery \$4.00 - 19	90 thru 1996	U.S. Delivery S	6.50, Foreign D	elivery \$8.50,	Ctata	7:0

Canada & Mexico \$7.00 - All issues prior to 1990 U.S. Delivery \$3.00, Foreign Delivery \$4.00. (Call for availability) These prices include: postage (US), surface mail (foreign). All checks must be in U.S. funds and drawn on a U.S. bank. es you would like by checking () the boxes. Send re Back Issues, One Phoenix Mill Lane, Peterborough, N.H. 03458, (603) 924-9281

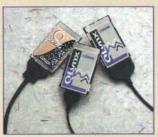
Charge:

American Express

A Division of The McGraw-Hill Companie



Your Specialty PCMCIA Headquarters



If your needs are portable, Quatech has the solution. Our complete line of communication and data acquisition PCMCIA cards include:

1.2. or 4 Port Serial RS-232/422/485 PCMCIA Cards Parallel Port/EPP PCMCIA Cards Multi-Protocol PCMCIA Adapter Cards Digital I/O PCMCIA Cards Analog Input and/or Output PCMCIA Cards **IEEE 488.2 PCMCIA Interface Cards**

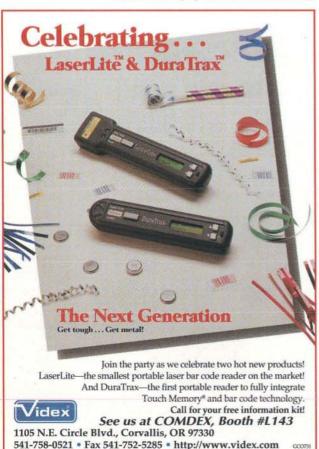
For complete specifications on the above products, call one of Quatech's expert sales engineers today at 1-800-553-1170 or email sales@quatech.com. Ask for a free copy of Quatech's new 1997 Product Catalog.

GUATECH

.....Application to Solution

Check us out on the web: http://www.quatech.com See us at COMDEX, Booth #\$3385

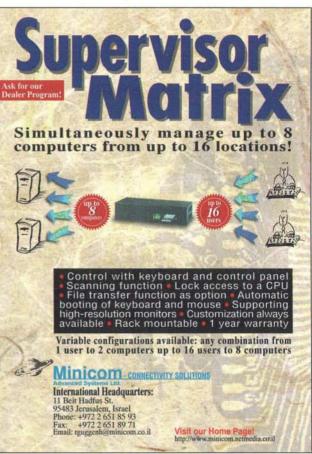
Circle 61 on Inquiry Card (RESELLERS: 62).



Communications/Networking



Circle 64 on Inquiry Card.



Circle 66 on Inquiry Card.



TAKE CONTRO

of 2 to 64 SERVERS

FROM ONE KEYBOARD, MONITOR AND MOUSE

- · Any mix of PCs; Mac, and Sun
- · Keyboard/mouse emulation
- AUTOSCAN
- · Front panel & Hot key operation
- Remote access to 150'
- · Desktop or rack mount
- Over 50,000 in operation

MasterConsole®

Rock solid, reliable control



CALL TODAY! 800-RCI-8090 X 71

Come see us at Comdex Fall, Las Vegas, Nov 18-22, Booth #L5000

DISTRIBUTORS LOCATED WORLDWIDE

RCI Europe (31)-10-458-6673 fax (31)-10-451-9610

RCI Taiwan (886) 2-218-1117 fax (886)-2-218-1221

Raritan Computer, Inc. 908.874.4072 fax 908.874.5274 10-1 llene Court, Belle Mead, NJ 08502 ■ sales@raritan.com ■ http://www.raritan.com

30 DAY MONEY-BACK GUARANTEE FULL 1-YEAR WARRANTY

Circle 67 on Inquiry Card (RESELLERS: 68).

DON'T **GET YOUR MESSAGES!** TTI's New 4-PLAY Voice Processing Card & Voice Window Application Software PEACE OF MIND FOR UNDER A THOUSAND DOLLARS MC/VISA/AMEX rs/OEM Packages Available International Sales and Sup Talking Technology, Inc. 1125 Atlantic Ave. Alameda, CA 9:501 USA Phone: 510 522-3800Fax: 510 522-5556 Email: sales@tti.net Webs.usp//www

Circle 65 on Inquiry Card.

Industrial PG Chassis with Industrial AG / DG Power Supply

- ISA/PCI 3~20 Slots
- 85V~265VAC, -48VDC. +24VDC, +12VDC Inputs
- 200W~350W Power Supply
- . 19" Rack-Mount / Wall-Mount

3 ~20-Slots Chassis Available!! **ACI Systems**

Western Region: 1-800-983-1177 Eastern Region:

1-800-886-2243

Circle 80 on Inquiry Card (RESELLERS: 81).

Industrial PC Solutions



Rackmount PCs

Industrial PC Chassis

Industrial Workstations

Panel Display PCs

Pentium/486/386 CPU Cards

RS-232/422/485 Interface

Analog and digital I/Os

Data Acquisition



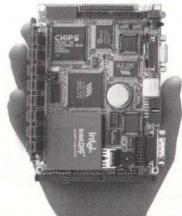
ADVANTECH.

750 E. Arques Ave. Sunnyvale, CA 94086 408-245-6678, Fax 408-245-8268

Circle 71 on Inquiry Card.

Embedded PC

Fits your applications and budget!



Biscuit PC 386/486 Single **Board Computer** with SVGA/LCD

and more ...

- Ultra small size (145mm x 102mm)
- Supports all 486DX and 5x86 CPUs
- Local-bus SVGA/LCD interface
- · Multi-port RS-232 and Ethernet communication
- Supports Solid State
- PC/104 expansion

Call Today for a Free Catalogue !



Tel: (408)522-4696 Fax: (408)245-8268 E-mail: info@Advantech-USA.com International Tel: 886-2-2184567 Fax: 886-2-2183875

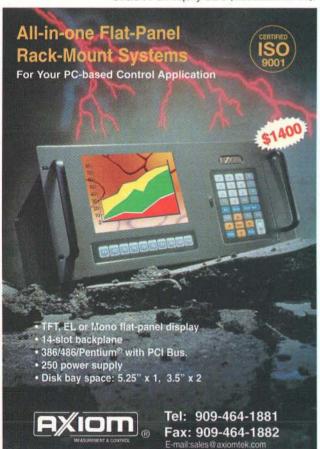
http://www.advantech.com.tw E-mail: EBC@acl.advantech.com.tv

Circle 72 on Inquiry Card.

Computer Systems



Circle 77 on Inquiry Card (RESELLERS: 78).

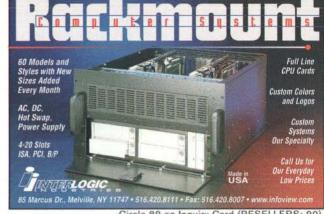


Circle 82 on Inquiry Card (RESELLERS: 83).



Circle 84 on Inquiry Card (RESELLERS: 85).

Computer Systems



Circle 89 on Inquiry Card (RESELLERS: 90).

NEW! 386 PC-IN-A-BOX



CPU CARDS

5-Serial Port 386

\$249+

KS-6B CPU: 33 MHz, RS-422/485, 2 parallel, 4M Dram, 1M Flash, 512K Sram, AT bus, PCMCIA, DOS in ROM.

Low Cost XT

\$139+

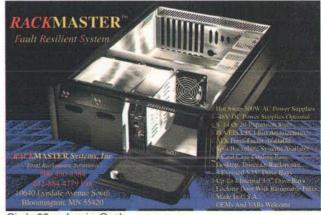
KS-1 CPU: V40, 3 serial, 2 parallel, 512K Dram, 1M Flash, 512K Sram, modem, 10 bit A/D, PCMCIA, XT bus, DOS in

ROM

CALL 800-505-6749

303-444-7737 FAX 303-786-9983 email: sales@kila.com

Circle 73 on Inquiry Card.



Circle 88 on Inquiry Card.

Computer Systems

Board Computers



A large variety of SBCs in stock for fast delivery

- 486 AND PENTIUM CPUs
- **UP TO 200MHZ SPEEDS**
- **PCI SCSI INTERFACE**
- E-IDE INTERFACE
- SVGA VIDEO OUTPUT
- **DUAL SERIAL PORTS**
- ISA & PCI BACKPLANES

CALL TOLL FREE 1-888-RECORTEC

Tel: 1-408-734-1290 Fax: 1-408-734-2140 e-mail: info@recortec.com http://www.recortec.com

RECORTEC

1290 Lawrence Station Road Sunnyvale, CA 94089

Circle 75 on Inquiry Card.

Mount Computers



Request our free **Product Catalog**

- COMPUTERS
- **ENCLOSURES**
- KEYBOARDS
- MONITORS
- **PRINTERS**
- **CUSTOM DESIGNS**

CALL TOLL FREE

1-888-RECORTEC

Tel: 1-408-734-1290 Fax: 1-408-734-2140 e-mail: info@recortec.com http://www.recortec.com

RECORTEC

1290 Lawrence Station Road Sunnyvale, CA 94089

Circle 76 on Inquiry Card.

Computer Systems • Data Acquisition



PENTIUM, 486 Single **Board Computers** & Mother Boards

ORDER DESK 1-800-777-4875

US LOGIC

(619) 467-1100 • FAX (619) 467-1011 sales@uslogic.com

The Intel Inside Logo and Pentium are registered trademark of Intel Corporation. 3 year warranty applies to Single Board Computers.



RAVEN PENTIUM PCI/ISA FALCON IV 486 Single Board RACK MOUNT SYSTEMS

- On-Board IDE/FDD/IO · REV Control · AMI BIOS
 - · OPTI CHIPSET



Circle 86 on Inquiry Card (RESELLERS: 87)

2 GS/s A/D and Scope Card



√ 12 bit, 60 MSPS A/D

√ 8 bit, 250 MSPS A/D

- 2 GS/s for repetitive signals
- Up to 16 Meg Memory
- **Extensive Software Drivers**



CS2125 8 bit, 250 MSPS \$4995 CS6012 12 bit, 60 MSPS \$6995 U.S Prices. International prices may vary

Gage Applied Sciences (U.S.) Inc. 1233 Shelburne Road, Suite 400

South Burlington, VT 05403 Tel: (800) 567-4243 Fax: (800) 780-8411 e-mail: prodinfo@gage-applied.c web site: http://www.gage-applied.com

sal, OC. Canada H4S 1A9 Tel: (514) 337-6893 Fax: (514) 337-8411

Circle 104 on Inquiry Card.





Circle 74 on Inquiry Card.

IEEE 488 Controllers

Boards for PC/AT, PCMCIA" PCI, parallel, serial, Sun" workstations & DEC" workstations

Ask for extension 3425

Drivers for DOS", Windows' Windows 95, Windows NT LabVIEW, UNIX", & more

216-439-4091 * Fax: 216-439-4093 http://www.iotech.com



Circle 105 on Inquiry Card.

BYTE

Breaks the 4-Color Price Barrier with the Hardware/Software Showcase

See how affordable it is to advertise to BYTE's 500,000 computer professionals in this section!

For more information call your BYTE sales representative (see listing, page 233) or fax 603-924-2683

DAQValue[™]

Portable Data Acquisition

Performance and Portability -We Give You Both.



DAQCard" Series

 Six Type II PCMCIA cards Up to 100

ksamples/s

 12-bit resolution Analog input and output Digital I/O

and timing I/O

SCXI Signal Conditioning

 Parallel port or PCMCIA interface

Expandable to 384 channels

DC power, optional battery pack

DAOPad" Series

 Parallel port interface 100 ksamples/s

• 12 or 16-bit resolution

 Analog, digital, and timing I/O

 DC power, optional battery pack

Software

· NI-DAQ* driver software for: LabVIEW⁹

LabWindows*/CV ComponentWorks

Basic, C/C++ Visual Basic, Pascal, and many more

Call for FREE DAQ Designer Software





U.S. Corporate Headquarters • Tel: (512) 794-0100 • Fax: (512) 794-8411 E-mail: info@natinst.com • WWW: http://www.natinst.com

© Copyright 1996 National Instruments Corporation. All rights reserved.

Product and company names listed are trademarks or trade names of their respective companies

Circle 106 on Inquiry Card.

Custom

SCSIVue "Active

Terminator

 Improves SCSI Bus Performance Less Errors; More Reliable Data Transfer

Diagnoses Problems
 Analyzes Signal Quality

Active Regulation • Supports 68 Pin, 50 Pin

Status Indicators
 Gold Contacts



From SCSIVue™ Gold Benefits: Diagnostic Cables No Loss Of Important Data

 Faster Performance
 Test Cable Integrity Diagnostic Indicators
 Large Ferrite Filters

Triple Shielding (Unique Cable Design)
 Double Gold 20u" Plated Connectors

Extra Heavy 26 Gauge Wire, 50 & 68 Pin

SCSIVue Teflon

Custom Internal Cables

 Less Errors, Ultimate Performance Silver Wire Improves Signal Quality

Perfect 90 Ohm Impedance Match Triple Pronged Connector With Gold contacts

Custom Internal Cables in 1 DAY!



SCSIVue[™]Active Digital Switch Benefits

 Share SCSI Devices Between 2 Computers Attach up to 14 Devices to 1 Computer

2-1 Active Digital Switch/Repeater Regenerates SCSI Signal for Long Runs The SCSI Solution Company

http://www.scsipro.com 3101 Whipple Rd. • Union City, Ca. 94587 • Ph: 510-471-6442 • Fax 510-471-6267

Circle 91 on Inquiry Card (RESELLERS: 92).

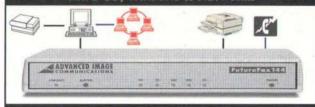
Computer/LAN Tools and Diagnostics Call for a free copy of the new Jensen Catalog for all of your PC/LAN diagnostic products and installation accessories. IENSEN TOOLS 7815 S.46th St. Phoenix, AZ 85044 Ph: 800-426-1194

Diagnostic Equip. Fax Boards/Machines Memory/Chips/Upgrades

Circle 108 on Inquiry Card (RESELLERS: 109).

Introducing The Fax Modem That Stands Alone... The FutureFax 144

> ADVANCED MULTI-FUNCTION FAX SYSTEM FOR DOS, WINDOWS & NETWORKS



- ☑ Send/Receive Faxes With Your PC Turned Off!
- ☑ Print Plain Paper Faxes Directly To Your Printer and save hundreds of \$ on thermal paper.

☑ STORES FAXES IN MEMORY

FAX: 800-366-9662

http://www.jensentools.com

☑ VIEW FAXES BEFORE PRINTING

☑ FORWARD TO REMOTE LOCATION ☑ UP TO 32MB OF MEMORY

☑ COMES WITH FREE SOFTWARE ☑ AC OR BATTERY OPERATION ✓ SUPPORTS CAS APPLICATIONS

SEND FAXES WITH ANY SCANNER

☑ V.42, MNP DATA MODEM

☑ AND MUCH, MUCH MORE!!

Call our 24 Hour Fax-On-Demand System for FREE Information.

1-888-GET-FAX4





ADVANCED IMAGE COMMUNICATIONS 3343 VINCENT RD. #D PLEASANT HILL, CA 94523 FAX 1-510-947-1900

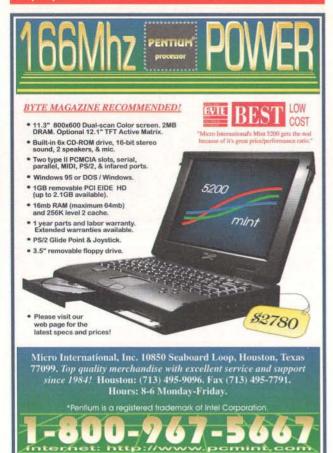
Circle 93 on Inquiry Card.



http://www.camusa.com

816 Charcot Ave., San Jose, CA 95131 Tel: 1-408-321-9880 Fax: 1-408-321-9885

Circle 94 on Inquiry Card (RESELLERS: 95). NOVEMBER 1996 BYTE 223 Laptops & Notebooks • Misc. H/W • Multimedia





NEVER install Windows 95 Again!

CodeBLue/2

- · Simple As 1-2-3
- 1. Boot disaster recover diskette

Multimedia • Programmable H/W

- 2. RESTORE to any size drive
- 3. Re-Boot to Windows 95

Complete protection

 Backup complete Windows 95 system: Registry, hidden files, LFN's ·Backup to any locally attached hard disk, Syquest EZ, Iomega Jaz & Zip drives, MO Drives.

Also works on Win NT with FAT 16 Hard Disk.

CodeBlue/2 REMOTE

- · For network disaster recovery
- · Backup to server
- · DOS Boot client to network
- Restore & reboot to Windows 95 Call for network license price

\$49.00

plus S/H

TAPEDISK Corp 800-827-3372

tapedisk@tapedisk.com http://www.tapedisk.com 715-235-3388 FAX:715-235-3818 TAPEDISK UK 1703-841 550 TAPEDISK EURO +49 84.41.80.39.00 Germany +49 761.59.21.00

The Netherlands +31 23 563 39 60 France +33 61.80.92.71

Circle 98 on Inquiry Card.



- 8 Mhz V-25 + Processor
- 512 KB RAM
- 256 KB Flash
- 2 Serial Ports
- EDN 100 Hot New Products of 1995



Single Board Computer with DOS and Utilities Embedded controller applications: Simple software development:

- 2 fast DMA channels * 8 analog inputs with programmable comparator levels * priority interrupt controller with vector or register bank switching.
- Create on a PC compatible computer.
- Download in .EXE or .COM format to flash disk
- Test and debug through the console serial port.

 Modify the startup batch file to load and
- execute the application on reset or po

K microsystems

510 236-1151 fax 510 236-2999

http://www.dsp.com/jkmicro



1275 Yuba Ave., San Pablo, CA 94806



Circle 102 on Inquiry Card.

Postal: 1385 Greg St. Suite 101 Sparks, NV 89431 Circle 96 on Inquiry Card (RESELLERS: 97).

Fax:1-702-356-6361

and manufacturing company specializing in computer enclosures, disk subsystem enclosures and fully integrated systems.

Design, Print and Apply CD Labels That's

Engineering

Industrial PC Enclosures Tower PC Enclosures

Tower Drive Enclosures

Rackmount Accessories

Phone: 1-702-356-5595

CPU Cards and Backplane

Industrial PS2 Power Supplies

Internet: http://www.sliger.com

Rackmount Drive and PC Enclosures

Redundant N+1 Load Sharing Power Supplies

Rack Systems

Email: info@sliger.c

is a vertically integrated design

Design • Fabrication

Now Supporting

- 1 Create your own artwork On Your Computer with easy-to-use NEATO Templates
- 2 Print on Any Laser Printer using NEATO pressure sensitive die-cut labels
- 3 Using the NEATO Label Device, apply labels... PERFECTLY EVERY TIME!

 - Label Design Templates (PC & Mac)
 The Amazing Neato Labeler Complete Instruction Guide

800-984-9800

See us at: http://www.neato.com

Circle 99 on Inquiry Card.

Low Cost 16-bit Controllers Easy to program in Borland/Microsoft C/C++.

C-EngineTM Prices start at \$119 Qty 1, \$49 OEM

- · 3.6x2.3", 24 I/O, 3 UARTs, 3 timers 2 counters
- . Upto 512K SRAM, 512K EEPROM, Watchdog
- . 11 12-bit ADC . 3 mA standby. Battery, RTC
- · Networking, C library, Development kits



216 F St. #104, Davis CA 95616 USA Tel: 916-758-0180 Fax: 916-758-0181 nternet Email: tem@netcom.com ftp://ftp.netcom.com/pub/te/tern



NEAT .



WORLD

CORES

DMA

1724 Picasso Ave. Davis, CA 95616 916.757.3737 916.753.5141 FAX

For immediate information, use our 24-Hour AutoFAX. Call 916.753.0618 from your FAX. Request catalog #18.

Circle 100 on Inquiry Card.

http://www.zworld.com





Software Security's new UniKey® technology could change the way you think about software protection forever.

Even though our new hardware keys are small, they still offer the most powerful and reliable barrier against software piracy ever developed.

And with competitive pricing, they won't squeeze your margins either.

- · Secure protection for multiple applications/versions
- . The industry's only patented protection technology
- · Protects applications quickly, without programming
- Remote update capabilities
- DOS/Windows/95/NT/Unix/ NetWare support
- Time/date-based execution control
- · Made in U.S.A.

UniKey makes software protection easier on your customers, your developers, and your budget... but harder than ever on pirates.

Call 1-800-841-1316 for more information, or to order our Developer's Kit, with everything you need to try UniKey protection on your application.





A new slant on software protection 6 Thorndal Circle, Darien, CT 06820-5421 (203) 656-3000 • Fax: (203) 656-3932 http://www.softsec.com









Circle 107 on Inquiry Card.





Circle 103 on Inquiry Card.



Communications/Networking • Eng./Scientific • Math/Stats

the backbone mail system for Windows NT & Windows95"

- ♦ full featured SMTP, POP and FINGER server
- highly configurable, secure list server
- multiple independent mail domains on a single machine
- graphical installation and configuration

From Only \$49

A FREE FULLY FUNCTIONAL TIME LIMITED EVALUATION COPY IS AVAILABLE ON OUR WEB SITE

Internet Shopper Limited - PO Box 6064 - London - SW12 9XG - ENGLAND ① 011 44 181 673 7422 http://www.net-shopper.co.uk

Circle 112 on Inquiry Card (RESELLERS: 113).

ENGINEERING SOFTWARE CATALOG



Engineering Software Direct is your #1 source for engineering software! The more than 1,000 products listed in this catalog were developed by companies and practicing engineers and represent a vast resource of tools that can help you get your job done better, more accurately, and more quickly.

ral 2525 N. Elston Ave., Chicago, IL 60647 • Tel 773.486.9191 Fax 773.486.9234 • e-mail info@scitechint.com • URL http://www.scitechint.com

Circle 114 on Inquiry Card).

Simple Software from Clou Consulting Co.

DOS OS/2 WIN Computer algebra by keyboard entry.

Something for everyone. Arithmetic, algebra and MORE. Practical and useful. No language to learn. Free upgrades.

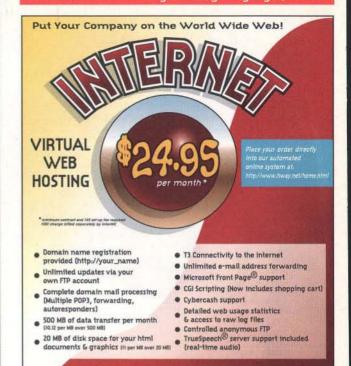
Simply \$67.00 plus shipping.

Order: 1-800-226-0640 Fax: 612-553-0147 VISA MC AM-EX

1400-F Hwy 101 North, Suite 183, Plymouth, MN 55447

Circle 115 on Inquiry Card (RESELLERS: 116).

On-Line Services • Programming Languages/Tools



Circle 117 on Inquiry Card (RESELLERS: 118).

Hiway

Technologies

sales@hway.nel (407) 989-8574



Real Audio 2.0 SSL Secure Processing mSQL Database Tools

http://www.hway.net 1800 339-H,W,A,Y,

Fortran is our forte

Specializing in Fortran Language Systems Since 1967

The Lahey Advantage

FREE, unlimited. expert technical support.

Guaranteed bug fixes or workarounds within 60 days.

30-day

guarantee.

FREE

product patches

on the Web at

http://www.lahey.com.

800-548-4778

702-831-2500

Fax: 702-831-8123

sales@lahev.com

http://www.lahev.com

Delivers! Speed. Dependability.

Great Tech Support.

Create Fortran programs or port legacy code to the PC with the most-productive, best-supported Fortran 90 language system.

Labey Fortran 90

Fortran-smart Windows **Development Environment.** money-back DOS, Windows 3.1x,

Windows 95 and NT Support. mp://www.lahey

 DLL interfaces to VB, VC++, and Borland C++.

State-of-the-Art Intel Pentium and Pentium Pro Optimizations.

Educational, multiple-copy, and site-license pricing available.

Lahey Computer Systems, Inc.

865 Tahoe Blvd., P.O. Box 6091 Incline Village, NV 89450 U.S.A.

Circle 119 on Inquiry Card (RESELLERS: 120).

Programming Languages/Tools

Learn Java™ Programming... Simply, Quickly!

Use the OML Learning Series" to master Java programming quickly. It is the only CBT that offers you "traditional" and "by example" learning styles. The Java Series features:

Java Series - I" Java Series - II™

Java Series - III" Java Series - IV"

Call us for information. and FREE 100 100 600 **Demo Software**

Each series: \$79 \$249 Any 2 series: \$149 \$399 Any 3 series: \$199 \$549 All 4 series: \$249 \$649 Other series Call

800-6789-OML

OBJECT MANAGEMENT LABORATORY TEL: 805-373-8111 FAX: 805-373-8116

Circle 121 on Inquiry Card.

A Message to Our Subscribers

From time to time we make the BYTE subscriber list available to other companies whose products or services would be of interest to our readers. We take great care to screen these companies, choosing only those who are reputable. Furthermore, subscriber names are made available for direct mail purposes only; telemarketing calls are strictly prohibited.

Many BYTE subscribers appreciate this carefully managed program, and look forward to receiving information of interest to them via the mail. While we believe this information is of benefit to our subscribers, we firmly respect the wishes of any subscriber who does not want to receive promotional literature. Should you wish to restrict the use of your name, please send your request (including your magazine mailing label, name, address, and subscription account number) to

BYTE Magazine Subscriber Services PO Box 555, Hightstown NJ 08520

A Division of The McGraw-Hill Companies

Security

"Run Client/Server Applications Securely over the Internet"





- Use the Internet as a secure virtual Wide Area Network
- Develop powerful Internet applications using 4GL tools
- Use SQLWindows, Visual Basic, Powerbuilder, Delphi, C++...
- Provides automatic data-stream encryption for all SQL data
- Uses RSA security and Netscape's secure socket references
- Includes a complete enhanced version of SQLBase v6.1 Transparent to users, developers and administrators

Use the Internet to securely access your client/server applications

Use Client/Server tools for remote access solutions!

Pricing starts at \$1,595 for a 5-user version Call 1-800-486-DUNN ext. 405 http://www.dunnsys.com







DUNN systems, inc.

Circle 122 on Inquiry Card.

The First Pan-European **Computer Postcard Deck** Targeting the **Exploding European Market!!!**

If you are a BYTE subscriber in Europe, watch for the **EURODECK coming to you soon! The BYTE EURODECK** contains a selection of state-of-the-art products important to you and your business.

Advertisers!

The BYTE EURODECK offers you a unique direct mail approach to increasing sales in this fast-paced computer market.

Circulation of the BYTE EURODECK is targeted to 50,000 computer buyers in over 20 countries in Western Europe. Take full advantage of the benefits BYTE provides you with this affordable direct channel to Europe. For information on the next BYTE EURODECK,

> Call Mark Stone today at 603-924-2533! Fax 603-924-2683 or E-mail: stonem@mcgraw-hill.com

Companies outside of North America, please contact your local representative BYTE

A Division of The McGraw-Hill Companies



THE BUYER'S MAR

THE BUYER'S MART is a unique classified section organized by product category to help readers locate suppliers. Each ad has Inquiry numbers to aid readers requesting information from advertisers

AD FORMAT: Each ad will be designed and typeset by BYTE. Do NOT send logos or camera-ready artwork. Advertisers should furnish typewritten copy. 2"x1 1/16" ad can include headline (23 characters maximum), descriptive text (300 characters is the maximum recommended) plus company name, address, telephone and fax number. 2"x2 5/8" ad has more space for descriptive text (850 characters is the maximum recommended). **DEADLINE:** Ad copy is due

approximately 2 months prior to issue date. For example: November issue closes on September 8. Send your copy and payment to:

Magazine, 1 Phoenix Mill Lane, Peterborough, NH 03458. For more information please call Vivian Bernier in BYTE sales at 60

RATES (Jan. 1996)									
		3-5 issues	6-11 issues	12 issues					
	1 ad	\$790	\$760	\$665					
2"x11/6"	2 ads/is	sue -	-	635					
	3 ads/is	sue -	=	600					
	1 ad	\$1,580	\$1,515	\$1,330					
2"x25/6"	2 ads/is	sue -		1,265					
	3 ads/is	sue -	- 3	1,200					
******	·COLOR	- Add \$	100	*****					

ACCESSORIES

SVGA Splitters Monitor, Keyboard and Mouse splitters, multiplexers and

high quality cables to 250 feet.

- Connect 2 or more monitors to your PC
- ➤ Support to 1600x1200 MADE IN USA
- > Access 1 PC from several keyboards or vice versa > SVGA < > TV Converters

HALL RESEARCH http://www.hallresearch.com

Santa Ana. CA (714) 641-6607

800-959-6439

BAR CODE

Windows Bar Code Fonts

Add bar codes to any font based Windows program. Fonts designed for dot matrix, DeskJet and LaserJet. Print Codabar, 2 of 5, Code 128, UPC/EAN and Code 39 inside your Windows program. TrueType fonts, bitmaps and metafile support included. Only \$199.

Worthington Data Solutions (408) 458-9938

(800) 345-4220

BAR CODE

Labeling Software

For DOS and Windows with dot-matrix, LaserJet or DeskJet. Easy WYSIWYG design. Any format/size. Mix big text, bar codes, and PCX graphics. Formats for AIAS, KMart, Sears, MIL-STD, Penneys, WalMart. File Input. LabelRIGHT for DOS-\$279. LabelRIGHT for Windows—

30 Day Money Back Guarantee

Worthington Data Solutions (408) 458-9938 800-345-4220

RF Terminal

Communicates 2 way to Serial Base Station from 400-1000 ft. Easily covers 1,000,000 square feet.

1-16 terminals per base station. Keyboard, wand,
CCD or laser scanner input. 16 Selectable frequencies. Small size and low weight – 14 oz. with
batteries. Base Station – \$845 Terminal – \$1095.

http://www.cruzio.com/~wds Worthington Data Solutions

, CA 95060 800-345-4220 408-458-9938 • FAX 408-458-9964

Bar Code Readers

for PC, XT, AT, PS/2, Macintosh and Serial Terminals

- Attaches as 2nd Keyboard, no software changes
- Reads 2of5, 128, UPC/EAN, Code 39, etc.
- External or Internal attachment on PC
- * Wand, CCD, Slot Badge, Magstripe or Laser
- * Supports DOS, Novell, UNIX, Mac OS, etc.
- 100+ Configurable Options
- * Supports USA and International Keyboards
- * 2 Year Warranty, 30 Day \$ Back Guarantee
- * Direct From Manufacturer
- * Top Rated by Independent Review
- ★ Complete with CCD Scanner \$399
- ★ Complete with Laser Scanner \$655
- ★ Complete Wand only Reader- \$299 http://www.cruzio.com/~wds

Worthington Data Solutions

3004 Mission Street • Santa Cruz, CA 9506

408-458-9938 • FAX 408-458-9964 800-345-4220

Portable Reader

- AA Battery Operated, 64K or 256K
- * Display messages and optional voice messages tell operator what to do. Messages are easily recorded (like answering machine) in any language. This unit is EASY
- ★ Double duty as Non-portable Reader
- * 4x20 Supertwist LCD Display, 35 Rubber Keys
- * 2 Built-In Inventory Programs or create custom
- * Download tables and Pick Lists
- * Wand, CCD, or Laser Scanner Input
- * Reads 2of5, UPC/EAN, 128, Code 39, etc.
- * 2 year Warranty on Reader & Wand
- * 30 Day Money Back Guarantee
- ★ 64K Complete with Integrated Laser \$1299
- ★ 64K Complete with Steel Wand \$799
- * Small Size and very long battery life

http://www.cruzio.com/~wds **Worthington Data Solutions**

3004 Mission Street • Santa Cruz, CA 95060 408-458-9938 • FAX 408-458-9964 800-345-4220

Portable Bar Code Reader

- ➤ Use as a PORTABLE, WEDGE, or SERIAL
- ➤ 9V Battery Operation with Lithium Backup
- > 2x16 Supertwist LCD Display
- > 54 Key Keyboard with Separate Numeric Keys
- > Real-time Clock Supports Date & Time Stamps
- ➤ Reads all Popular Bar Codes (16 types)
- ➤ Wand, CCD, Laser, or Serial Input Devices
- ➤ Built-In Program Generator
- ➤ Create Your Own Custom Programs
- ➤ 6 Built-In Inventory Programs
- Up to 250 Programs Can Reside in Memory
- ➤ Create up to 250 Data Files per Program
- ➤ Up to 250 Look-Up Files in Memory
- ➤ Built-In Calculator
- ➤ Supports HAYES Compatible Modems
- ➤ 64K Memory with Data Compression
- > 30-day \$\$ Back Guarantee 1 Year Warranty
- ➤ Complete Unit with WAND Scanner \$795

AMERICAN MICROSYSTEMS

2190 Regal Parkway, Euless, TX 76040

(800) 648-4452 (817) 571-9015 FAX (817) 685-6232

www.amltd.com

BAR CODE

BAR CODE READERS

For PC, XT, AT, PS/2, & Serial Terminals

- Emulates Keyboard: Works With Any Software
- Data Appears as Keyboard Input
- Uses Enhanced Decoding Algorithms
- Accepts Wand, Slot/Badge, CCD, Laser, Magnetic Stripe Reader, & RS232 Serial Input
- Reads All Popular Bar Codes (16 types)
- Reads HIGH, MEDIUM, & LOW density codes
- Auto-Discriminates Between Bar Code Types
- Easily Programmed with a Bar Code Menu
- Over 140 User Configurable Options
- Daisy Chain Up to 96 Readers
- Supports NOVELL Networks
- Supports US & INTERNATIONAL Keyboards
- Direct From Manufacturer
- 30-day \$\$ Back Guarantee, 1 Year Warranty
- Complete Unit with LASER Scanner \$645
- Complete Unit with CCD Scanner \$299
- Complete Unit with WAND Scanner \$299

AMERICAN MICROSYSTEMS 2190 Regal Parkway, Euless, TX 76040

(800) 648-4452 (817) 571-9015 FAX (817) 685-6232 www.amltd.com

Bar Code Printing Software LabelWorks for Windows

- ➤ Prints all Popular Bar Code Types (19 Types)
- ➤ Desktop Publishing Features: WYSIWYG, Scalable Fonts, Rulers, Guides, Lines, Shapes, Page Zooms (25%-400%), Templates
- ➤ Rotates Text, Bar Codes, and Graphics
- ➤ Supports Windows Compatible Fonts
- Choose From Over One Hundred Popular Label Formats or Design Your Own
- ➤ Rich Text Support: Mix Styles, Types, & Sizes
- ➤ Automatically Prints Serial Numbers
- ➤ Imports & Exports Graphic Files: TIFF, GIFF, BMP, PCX, WPG, WMF, TARGA
- ➤ Supports Virtually all Windows Compatible Printers (PostScript, Laser, & Dot Matrix)
- ➤ 30-day Money-Back Guarantee, \$295
 - ** CALL FOR FREE DEMO SOFTWARE ***

AMERICAN MICROSYSTEMS

2190 Regal Parkway, Euless, TX 76040 (800) 648-4452 (817) 571-9015 FAX (817) 685-6232 www.amltd.com

WINDOWS™ LABEL PRINTER

GEMINI is the ADC industry's first Windows-only label printer. Impeccable print quality, rugged all-metal construction, many bonus features standard; allows you to print labels and bar codes from the Windows applications you already use, without special labeling software or programming. Reseller inquiries welcome.

THARO SYSTEMS, INC.
P.O. Box 798, Brunswick, OH 44212-0798
http://www.tharo.com/tharo/ Internet e-mail: tharo@tharo.com 330-273-4408 Fax: 330-225-0099

Inquiry 451.

BOOKS

12,000 COMPUTER TITLES

Easy browsing & ordering in our online stores Computer books from 450 publishers. Web URL http://www.compubooks.com. Excellent customer service & technical assistance. Worldwide FedEx & USMail shipping. MC/Visa/AmEx/Novus/JCB cards.

CompuBooks® Online Bookstores 512-321-9652 Fax 512-321-4525 800-880-6818

BUSINESS SOFTWARE

Accounting Software http://www.capitalsoft.fi

☐ 100% C++/MFC ☐ Source Available ☐

Ov Capital Soft Ltd

Tekniikantie 12, FIN-02150 Espoo, Finland Phone: +358-9-4354 2450 Fax: +358-9-455 8508

Inquiry 452

CAD

Circuit Design Software for Windows Easy-to-use schematic entry, PCB design, and sim-ulation software, starting at \$149 each. Complete PCB package with schematics, autorouter, and layout for 2-layer circuit boards, \$399. Enhanced version with autoplacement, more symbol libraries, and up to 16 layers, \$649. CAM file outputs.

Mental Automation, Inc.

5415 136th Place, SE-Bellevue WA 98006 (206) 641-2141 FAX (206) 649-0767 BBS (206) 641-2846 http://www.mentala.com/

Inquiry 453.

CAD/CAM

CONTOURING MOTION CONTROL FROM A PRINTER PORT!

\$249 **VERSION 3** VISAMIC

Controls up to six step motors simultaneously.
Linear and Circular Interpolation.
New features to accommodate machine control.

Easy-to-use device driver, Super Manual.
 CAD-CAM interface available.

Ability Systems http://www.abilitysystems.com

Corporation, 1422 Arnold Aw Roslyn, PA 19001 (215) 657-4338 FAX: (215) 657-7815

Inquiry 454

CAD Solutions Software TG-CAD Professional v.6.0

A 16 & 32 bit C/C++ Windows 95, Win NT & Win 3.1 CAD Developers Kit. The best in CAD/CAM soft-ware kits. Free Demo and Technical Paper. 1-800-635-7760

Fax: 214-423-7288 BBS: 214-881-9322 Disk Software, Inc. P.O. Box 941152, Plano, TX USA 75094 E-Mail: disksoft@ix.netcom.com

Inquiry 455.

Inquiry 456

CD-ROM

Consolidated CDROM, Inc

Worldwide suppliers of CD-ROM software. We do import, export, publishing & distribution. We also buy & sell all types of memory chips. Dealers Wanted!

102 Greenwood Ave Wyncote PA 19095 USA 800-8CD-ROMS 215-572-9831/215-572-9832 fax Email: cdrom@consldcdrom / www.consldcdrom.com

Inquiry 460.

CD-ROM

į	CD-ROMS
į	JAVA - Dev Kit,
ı	HotJAVA browser, demo applets, on-line docs WINDOWS 95.COM32-bit Shareware Collection
ı	
١	Utilities for Windows 3.1, NT, Windows 95, more!
ı	HOBBES OS/2\$35.00 Software, games, utilities, fixes, updates
ı	BSDISC - NetBSD, FreeBSD, XFree86 & X11R6\$35.00
J	INTERNET TOOLS \$30.00 Networking tools & utilities SLIP & PPP
1	Networking tools & utilities SLIP & PPP
ı	LINUX Developer's Resource \$25.00 Slackware. Red Hat!, more!
ı	LINUX Installation & Getting Started Guide\$7.50
1	245 pg manual
ı	LINUX TOOLBOX —
ı	MOO-TIFF for LINUX - 100% Motif compatible GUI\$99.00
ı	MOO-TIFF for FreeBSD - 100% Motif compatible GUI \$99.00
1	MOTHER of PERL \$35.00
ı	Source & binaries for UNIX, DOS, NT, MAC RUNNING LINUX \$19.95
ı	576 pg manual for everything about Linux
1	SOURCE CODE - 4.4 BSD-Lite2, GNU, InterViews, more \$30.00
1	STANDARDS - RFCs, IENS, ITU/CCITT BlueBook \$30.00 TCL/TK - software to develop X-Windows apps \$35.00
ı	TeX – typesetting tools for mathematical & scientific docs \$35.00
ı	WORLD WIDE Catalog\$30.00
ı	See the WWW without being on-line!
1	X-FILES - Complete sources for X11R6 & XFree86 \$35.00
ı	Phone Orders: 1-800-800-6613 We accept
ı	Fax Orders: +1-520-526-9573 MC, VISA & AMEX
ı	Int'l Phone: +1-520-526-9565 Web Orders: www.infomagic.com E-mail: orders@infomagic.com
ı	
ı	InfoMagic 11950 N. Hwy 89, Flagstaff, AZ 86004

Inquiry 457.

CD ROM TOWERS & JUKEBOX SERVERS FOR ALL OPERATING SYSTEMS! RAID NOW AVAILABLE

No Device Drivers/ MSCDEX needed, Complete Kit Networks CD Roms, unlimited user license, DISCPORT.

"JES, NONE BETTER AT ANY PRICE"

Call NOW: 1 (800) 482-1866 305-597-3980 http://www.jescdrom.com

Inquiry 458.

WALNUT CREEK CDROM FreeBSD 2.1.5 Rock solid Berkeley Unix for PC w/src.

2 disc set, easy install, 6 mo updates	\$39.95
Linux Slackware 96 4 disc set, Slackware 96 *OFFICIAL*	release
by Patrick Volkerding. Internet's favorite.	\$39.95
Cica MS Windows 2 disc set, 1900+ Windows programs games, drivers, fonts, shells, src. Indexes in German/	3,
Italian/French/English/Japanese. Quar. updates	\$29.95
Hobbes 0S/2 1000 MB Free/Shareware drivers, app's,	
	\$29.95
Simtel MSDOS, 2 discs, premier Internet technical,	
	\$29.95
Blackhawk - New Win. 95 shareware collection.	\$29.95
Internet Info 13,400 doc's. FAQs, FRCs, & IENs	\$39.95
Music Workshop Music prog., midi, demos, etc	
Project Gutenberg 560+ must-read works of literature.	*****
Each document is in ASCII format text	\$39.95
Scientific Library Technical shareware. DOS/Win	
POV-Ray Ray-tracing images, src, documentation	
70+ titles about Windows 95 & NT, games, Tci, peri, QRZ!	.00.00
Ham Radio, Music, Fonts, Royalty-free images	
nam nado, wost, ronts, noyalty-nee illages	

Call for your FREE catalog today! All our products have a one year unconditional guarantee!

1-800-786-9907

4041 Pike Lane, Ste D-215, Concord, CA 94520 +1-510-674-0783 Visa/MC/AMEx, Fax: +1-510-674-0821 orders@cdrom.com http://www.cdrom.com/

Inquiry 459

COMMUNICATION-VOICE/FAX

InfoOnCal **Your Communications Solution**

Customizable phone operator, voice mail box, and fax machine all in one! Create:

Automated tech-support

Co. news by voice or fax
Product lists

Pager

and much more! For OS/2, Win 95, Win 3.1, & DOS!

TTC Computer Products (972) 594-8103 Download the demo at www.InfoOnCall.com

COMMUNICATIONS

Frame Relay, X.25, BSC, HDLC, SDLC, PPP

Rock solid, compliant, inexpensive and robust PC APIs and router implementations. On board protocol support reduces

- For MS-DOS, Windows, Win NT, Unix, OS/2, Netware and others
- Routers interconnect any PC systems or LANs.
- Cards for 56khns to T1/F1
- Superior test and diagnostics including SNMP.

Sangoma Technologies Inc.

(800)-388-2475 • (905)-474-1990 • Fax: (905)-474-9223 E-Mail: dm@sangoma.com • Web: www.sangoma.com

DATA ENTRY SOFTWARE

DATA ENTRY SOFTWARE

Full featured, heads-down data entry with two-pass verification, edit language, output record reformat, operator statistics, key from images (NEW!), free tech support. For PC, PC LAN, S/36, AS/400.

FREE 30 day trial.

Computer Keyes 21929 Makah Rd... 206-776-6443 Fax 206-776-7210 Woodway, WA 98020 800-356-0203

DATA RECOVERY

We Can Save It!

All Platforms - All Storage Devices Proprietary techniques so advanced we rescue data others simply abandon.

DRIVESAVERS

Restoring data since 1985 1-800-440-1904

415-883-4232

Inquiry 461.

The Leader in Data Recovery

- Expertise in virtually every operating system & media storage device.
- 24-Hour support & emergency services available.
- Call for a FREE consultation!

ONTRACK DATA RECOVERY

MN: 1-800-872-2599 · CA: 1-800-752-7557 DC: 1-800-650-2410 • Europe: +44 1372 741999

Inquiry 462.

DATA RECOVERY when I.T. Matters

- Tape, Optical or C.D. Media
- Accidental Overwrites
 Hardware or Software Failure

VOGON

Europe

Tel +44 (0) 118-989-0042 Fax +44 (0) 118-989-0040 Tel 405-321-2585 Fax 8242 Tel +49 (0) 180-522-15 Fax +49 (0) 89-69-37-00-55

Inquiry 463

DATA/DISK CONVERSION

CONVERSION/DUPLICATION

Tape: 4mm, QIC, 8mm, DLT, 9-trk, 3480/90/90E Disk: 3", 31/2", 51/4", 8"

1-800-357-6250

Shaffstall Corporation

317-842-2077 Fax 317-842-8294 7901 Fast 88th Street sales@shaffstall.com Indianapolis IN 46256 http://www.shaffstall.com Since 1973

Inquiry 464.

EDUCATION

B.S. & M.S. In COMPUTER SCIENCE

B.3. & M.3. III CONTINUED SCIENCES Offers an indepth home study program to earn your Bachelor of Science
at home. B.s. subjects covered are: MS/DOS, BASIC,
PASCAL, C, C++, Data File Processing, Data Structures &
Operating Systems. Ms. program includes subjects in
Software Engineering and Artificial Intelligence. Ada and Using Windows courses also available. Accredited Member: World Association of Universities and Colleges.

AMERICAN INST. for COMPUTER SCIENCES

2101-BY Magnolia Ave., Suite 200, Birmingham, AL 35205

1-800-767-2427 • 1-205-323-6191

ENGINEERING SOFTWARE

ENTERPRISE WIDE VIEWING AND MARKUP

Use AutoVue Professional to view and mark up documents Gain access to over 160 file formats from engineering, vec tor, raster, hybrid, wordprocessor, spreadsheet, database, fax, and more. Supported formats include AutoCAD DWG, MicroStation DGN, TIFF, Word, WordPerfect, Excel, and more. Available for Windows, DOS, and UNIX.

Cimmetry Systems Inc.

(800) 361-1904 Tel: 514-735-3219 Fax: 514-735-6440

Inquiry 465.

FOREIGN LANGUAGES

WORLD'S LANGUAGE CENTER

Automatic Translation with a push of the button Chinese, Japanese, Russian, 150 languages Dictionaries - Fonts - Learning - OCR etc.

Best Prices • Best Service FREE CATALOG

TransLanguage Inc.

800-308-8883 Fax 714-279-9368 PO Box 18024, Anaheim Hills, CA 92807

Inquiry 466.

HARDWARE

Pre-Owned Electronics, Inc™

THE Independent Provider, serving the Dealer, Professional, Corporate, Government, and Educational Buyer since 1985.

APPLE II® & MACINTOSH® SYSTEMS • PARTS • EXCHANGE REPAIRS

Call for a Catalog...800-274-5343 Office: 617-778-4600 • FAX: 617-778-4848 125 MIDDLESEX TURNPIKE • BEDFORD, MA 01730

Inquiry 467.

HEWLETT-PACKARD

Buy - Sell - Trade

Laser, let ColorPro DraftPro DeskJet RuggedWriter DraftMaster Electrostatic Plotters Design.Jet

HP 9000 Workstations and Vectras also available

Ted Dasher & Associates Your Hewlett Packard Remarketing Specialist Phone: (205) 591-4747 Fax: (205) 591-1108 (800) 638-4833 E-mail: sales@dasher.com

Inquiry 468

INTERNET

GAMELON® INTERNET FILES

http://www.mengi.com

Build powerful, sophisticated programs with a fast 00 persistent data software library that fits the architecture of the Internet, Gather lumpy Internet data or use the Internet for program-to-program data exchange. Object nesting, hyperlinking, indexing, transaction management, and more.

* Solaris, Windows 31, Windows 95/NT, OS/2 (ask for Mac, Linux)

* APIs for C++, C, Visual Basic & Delphi (ask for JAVA)

Menai Corporation
1010 El Camino Real, Suite 370, Menlo Park, California 94025
(800) 426-3566 (U.S.) or (415) 853-6450
EAX (415) 853-6455 E mail: info@menai.com

Inquiry 469.

LANS

Little Big LAN

The most flexible network

- Peer to Peer LAN to 250 nodes
- \$75 total software cost not per nodel Link via serial, parallel, or Moderns
- Also via Ethernet or Arcnet, or mix!
- Typically only 40k of RAM

Information Modes

817-387-3339 / P.O. Drawer F, Denton TX 76202 Fax 817-382-7407 Orders 800-628-Orders 800-628-7992

Inquiry 470

LASERJET PCL VIEWER

Visual PCL- End-user & Developer Versions

View your multi-page PCL5e print files in Windows complete with all fonts and macros. Print to non-PCL printers. Fax using standard Windows soft-ware. Uses true PCL5e Intellifont typefaces and rendering software. Runs under Windows 95, NT and 3.x. Full evaluation available on Web site. 16/32 bit Libraries available for OEM integration.

Visual Software Fax: +44 1306 742 425 http://www.visual.co.uk

geddes@visual.co.uk

Inquiry 471.

PROGRAMMERS TOOLS

High-Speed xBASE Engine for Java...

C, C++, Visual Basic and Delphi programmers. Get multi-user compatibility with FoxPro, Clipper and dBASE files. CodeBase is portable between DOS, Windows and UNIX! Includes client/server option as well as data-aware custom controls and a visual report writer

FREE 30 day test drive! Call Sequiter Software Inc. for details. Phone 403 437-2410 FAX 403 436-2999

Inquiry 472

SECURITY

AZ-TECH SOFTWARE, INC.

Leaders in Software Security

EVERLOCK Safe-D EVERKEY

Phone: (816) 776-2700 x310 Fax: (816) 776-8398 * Dept: SMG-310 Internet: www.az-tech.com E-Mail: sales@az-tech.com

Inquiry 473

- THE ULTIMATE SOFTWARE SECURITY STOPCOPY family — UNCOPIABLE copy protection
 STOPVIEW software encryption
 NETLIMIT network license metering

- STOPVIEW software encryption
 NETLIMIT network license metering
 DOS, Windows (3.X, 95, NT), Mac, OS/2, support
 Machine Tie, Internet Protection, CD-ROM Protection,
 Serialization, Date & Execution Limitation, Registration,
 Remote Authentication, Concurrent User Limitation
 Our products destroy ALL of our competition

BBI Computer Systems, Inc. 14105 Heritage Lane, Silver Spring, MD 20906 800/TRY-ABBI * 800/879-2224 * 301/871-1894 * FAX: 301/480-7545 E-mail: bbi@bbics.com * Web: http://www.bbics.com

Inquiry 474

Cop's CopyLock II Professional software protection.

DOS, OS2, Win 3.1, Win 95, NT, Networks. CD-ROM and Internet Security.

Known and used world-wide since 1984.

www.linkdata.com LINK Data Security

Int'l: + 45 3123-2350 Fax: + 45 3123-8448

SECURITY

CRYPKEY SOFTWARE LICENSING SYSTEM

on with NO hard CrypKey is software copy protection that is:

- completely secure from any disk copy program
- perfect for CD-ROM or INTERNET distribution!
- cost effective, user friendly, and 100% guaranteed to satisfy!

CrypKey can increase your software sales:

- upsell options and levels of your software

- lease or demo your software by runs or time
- enable or upgrade your customers instantly

New! unique Ready-To-Try feature upon install allows 1 trial period only per customer. New! unique Add-On feature - add more options, levels, runs or time to existing licenses. New! CrypKey Instant-protects in just 5 minutes with no source

CrypKey is completely compatible with MS-DOS, MS-Windows 3.x, Win32s, Win95, Win NT, and manages network licenses on all Novell and Microsoft operating system based networks. CrypKey is produced by Kenonic Controls Ltd. – software and ineering since 1972.

Kenonic Controls Limited 7175-12th Street South East Calgary, Alberta, Canada T2H 286 (403) 258-6200 = Tax: (403) 258-6201

INTERNET: crypkey@kononic.com WEB: http://www.kenonic.com/crypkay.htm

Inquiry 475.

CRYPTO-BOX[™] locks in your profits!
The Marx CRYPTO-BOX is the result of 10 years

- experience in effective software protection.

 microprocessor controls ID codes, memory, dynamic
- algorithm and high speed data encryption remote access to passwords and counters
- · license metering in networks: single key per LAN

MARX International, Inc. See us at COMDEX in Las Vegas Microsoft Partner Pavilion #B06 404-321-3020 **1-800-MARX-INT** tax: 404-321-0760

Visit our Home Page: http://www.marx.com

Inquiry 476.

KEY-LOK II™ SECURITY

Software Piracy Prevention — Survival 14 years proves effectiveness. Active algorithm, programmable memory, counters, date control, remote update. No ID on device. Low pricing (e.g. \$16.50 each for 5).

No startup costs.

Also, ACCESS CONTROL systems and disk drive/system LOCKS

MICROCOMPUTER APPLICATIONS, INC.

3167 E. Otero Circle, Littleton, CO 80122 http://www.csn.net/keylok

1-800-453-9565 (303) 770-1917 FAX: (303) 770-1863

Inquiry 477.

SOFTWARE/DEVELOPMENT

ADVANCED DEVELOPMENT TOOLKITS

EDAT

Cimmetry System's Engineering Data Access Technology (EDAT) provides pro-grammers with complete access to CAD drawing information. Use EDAT to read, query, write and modify AutoCAD DWG, DXF, and MicroStation DGN formats. EDAT is available on Windows, Win 32s, UNIX and DOS.

VCET

View enable your application with VCET (Viewing and Conversion Enabling Technology), the most extensive viewing libraries. Add viewing capabilities for over 160 file formats within your Windows application in a matter of hours. The same technology used in AutoVue and other leading viewing and document management software.

Cimmetry Systems Inc.

(800) 361-1904 Tel: 514-735-3219 Fax: 514-735-6440

Inquiry 478.

SOFTWARE PACKAGING

FREE SOFTWARE PACKAGING CATALOG

erything you will need to Package, Distribute, flware!! From manuals and binders to mailers and Package, Distri

LABELS • LABELS • LABELS
For your disketles, plain or custom printed

dot matrix or laser printer... free sam free samples

Hice & Associates 8586 Monticello Dr., West Chester, OH 45069

Phone/Fax: 513-779-7977

Inquiry 479.

SOFTWARE/ENGINEERING

Analog/Digital Simulation!!

- · Windows, NT, DOS
- Windows, Nt., Doo
 Power Mac, Macintosh
 IsSpice4 Real Time SPICE
 Mixed Mode Simulation
 Windows, Nt., Doo
 More Than 5000 parts
 Waveform Analysis
 Full SPICE programs
 Full SPICE programs

- P.O. Box 710 San Pedro, CA 90733-0710
- Schematic Entry starting at \$95. Comp
 New AHDL Modeling Kit!! systems, \$595-\$2595 starting at \$95. Complete

More Than 5000 parts

. Model Libraries, RF. Power

MO. Box 710 San Pedro, CA 90733-0710 intusoft (310)833-0710, FAX (310)833-9658 intusoft Call for your Free Demo and information kit.

Inquiry 480.

SpiceAge*4W
Windows Analog Circuit Simulator
The "value for the dollar" package you've heard about!

High speed Interactive Real-time analysis: AC, DC,

Transient, Fourier, Temperature ♦ Fast primitives ♦ Added functions ♦ Gain, phase, Impedence, group delay, noise, reflection coeff, and MORE are included ♦ Starting at \$895

Tatum Labs, Inc.

1287 N. Silo Ridge Drive, Ann Arbor, MI 48108 313-663-8810 FAX 313-663-3640

Inquiry 481

SOFTWARE/GRAPHICS

The Next Generation of Imaging Toolkits™

lmageGear™ 6.0

AccuSoft announces the new standard in imaging toolkits, ImageGear™ 6.0, the successor to the top-selling AccuSoft Image Format Library™

New Features include:

- De Over 45 Raster Image Formats!
- Fastest JPEG, Group 3/Group 4
 Over 100 new API functions
- Available for all platforms
- New GUI functions
- Faster image display & transparency
- Display with sub-pixel accuracy
- Advanced image processing
- # Faster image compression
- New display features, effects, and more!

AccuSoft Corporation Call (800) 525-3577

www.accusoft.com TEL(508) 898-2770 / FAX (508) 898-9662 Dept. BM4

2 Westborough Business Park Westborough, MA 01581 USA

Inquiry 482.

WINDOWS

Free PPP, Get On-Line Immediately, Telnet to other BBS's, Surf the World Wide Web, 28.8k modems

1-914-346-1777

All You Pay For Is The Call

Inquiry 483

U.S. POSTAL SERVICE STATEMENT OF OWNERSHIP, MANAGEMENT AND CIRCULATION

(Act of August 12, 1970, Section 3685, Title 39, United States Code)

1. Title of publication: BYTE

2. Publication No.: 535-150

3. Date of filing: 9-12-96

4. Frequency of issue: Monthly

5. Number of issues published annually: 12

6. Annual subscription price: \$29.95

7. Mailing address of known office of publication: One Phoenix Mill Lane, Peterborough, NH 03458

8. Mailing address of headquarters or general business office of publisher: One Phoenix Mill Lane, Peterborough, NH 03458

9. Full names and addresses of publisher, editor, and managing editor: Publisher: John M. Griffin - One Phoenix Mill Lane, Peterborough, NH 03458; Editor: Mark Schlack

- One Phoenix Mill Lane, Peterborough, NH 03458; Managing Editor: Jenny Donelan One Phoenix Mill Lane, Peterborough, NH 03458

10. Owner: The McGraw-Hill Companies, Inc., 1221 Avenue of the Americas, New York, NY 10020. Stockholders holding 1 percent or more of outstanding common stock are: Donald C. McGraw, Jr.; Harold W. McGraw, Jr.; John L. McGraw; William H. McGraw; June M. McBroom; all c/o The McGraw-Hill Companies, Inc., 1221 Avenue of the Americas, New York, NY 10020; Bankers Trust c/o Proxy Unit, MS 7230, 648 Grassmere Park Drive, 2nd Floor, Nashville, TN 37211; BZW Barclays Global Investors, 980 Ninth Street, 6th Floor, Sacramento, CA 95814.

11. Known bondholders, mortgagees, and other security holders owning or holding 1 percent or more of total amount of bonds, mortgages, or other securities: None

12. Has not changed during preceding months.

13. Publication name: BYTE

14. Issue date for circulation data below: October 1996.

15. Extent and nature of circulation:

	Average No. Copies Each Issue During Preceding 12 Months	of Single Issue Published Nearest to Filing Date
A. Total No. Copies Printed (Net Press Run)	727,063	739,502
Paid and/or Requested Circulation Sales through dealers and carriest vendors, and counter sales	riers,	314,440
2. Paid or Requested Mail Subse	criptions413,658	409,923
C. Total Paid and/or Requested Circulation	543,709	724,363
D. Free Distribution by Mail Samples, Complimentary, and C	Other Free5,959	2,146
E. Free Distribution Outside the Ma Carriers or Other Means		9,545
F. Total Free Distribution		11,691
G. Total Distribution	558,253	736,054
H. Copies Not Distributed 1. Office use, left over, spoiled	8,127	3,448
2. Return from News Agents .	160,683	none to date
I. Total	727,063	739,502
Percent Paid and/or Requested Circ	ulation97.39%	98.41%

16. This Statement of Ownership will be printed in the November 1996 issue of this publication.

17. Signature and Title of Editor, Publisher, Business Manager, or Owner

John M. Griffin, Publisher

I certify that all information furnished on this form is true and complete. I understand that anyone who furnishes false or misleading information on this form or who omits material or information requested on the form may be subject to criminal sanctions (including fines and imprisonment) and/or civil sanctions (including multiple damages and civil penalties).

ADVERTISER CONTACT INFORMATION

To order products or request free information, call advertisers directly or send in the Direct Link Card by mail or fax! Let them know you saw it in BYTE!

				1 704 700	OVDEV OCHRITES		005 100 1001	1 00000	MODO COLUMNIA	-	
	A			704-705	CYBEX COMPUTER PRODUCTS CORP	CVI	205-430-4000	243-244	MICRO SOLUTIONS COMP PROD	203	800-295-121
67-768 0-81	ACCTON TECHNOLOGY	48IS 23	886 357 7026		D			245-246	MICRO SOLUTIONS COMP PROD	207	800-295-121
0-61	ACI	220	888-618-6188		DATA COMMUNICATIONS	40-41			MICROGRAFX	73	800-877-304
	ACORN COMPUTER GROUP		44 0990 329070		DATAPRO	211					
14	ADOBE SYSTEMS INC	153	800-521-1976	736-737	75/4/5/2076	48IS 39	+886-2-268-1964**	·	MICROGRAFX	176	800-877-304
			G0159		DEXON SYSTEMS LTD		+36-1-393-2618**	173	MICRONELECTRONICS	CII-1	800-362-730
31-732	ADONTEC GMBH	48IS 10	+49-7043-9000-21**	9.800.000000		22			MICRO-INTERNATIONAL INC	224	800-967-566
13	ADVANCED IMAGE	223	510-947-1000	500000000000000000000000000000000000000	DISTINCT CORPORATION	150	408-366-8933	174	MICRON ELECTRONICS	56-57	800-486-205
	COMMUNICATIONS			140	DISTRIBUTED PROCESSING	93	407-830-5522	175	MICRON ELECTRONICS	74-75	800-723-299
10-111	AEHOME CORPORATION	225	818-961-2499	2000	TECH			99	MICROPATENT	224	800-984-980
32-233	AIRMEDIA	162-163	714-644-8223	141	DOLCH COMPUTER SYSTEM	AS 117	800-995-7580		MICROSOFT	2-3	000.001.000
25-126	ALADDIN SOFTWARE SECU	RITY 78	212-564-5678	142-143	DTK COMPUTER INC	88	800-289-2385		CORPORATION	2-0	
	ALADDIN SOFTWARE SECU		212-564-5678	122	DUNN SYSTEMS	227	800-486-DUNN			136-137	
							ext 405	-	CORPORATION	190-191	
234	ALTEX COMPUTERS & ELECTRONICS	202	800-531-5369		F				MICROSOFT	188	
		040	000 000 0000		Bee			N	CORPORATION	100	
4	AMERICAN ADVANTECH	219	800-800-6889	185-186	ELEKTROSON BV	191	+31-40-2515-065		MICROSOFT PRESSINC	01	800-MSPRES
2	AMERICAN ADVANTECH	220	800-800-6889	738-739	E-TECH	48IS 31	+886-35-777751**			91	
1	AMERICAN ADVANTECH	220	800-800-6889	706-707	EUTRON	48158	+39 35 201003		MICROWAY	100	508-746-734
29	AMERICAN POWER	32A-B		(0.0 F 10000	EXABYTE EUROPE	4815 29	+31 20 254 0090	66	MINICOM/CLASSNET VIDEO	219	+972-2-51859
	CONVERSION			700 700	ENDITE CONOTE	401525	101 20 204 0000	153	MINITABING	168	814-238-328
29	AMERICAN POWER	33	401-788-2797**		-			229	MIPS DATALINE AMERICA INC	165	619-679-407
	CONVERSION	123	17761676767777	144	FAIRCOM CORPORATION	187	314-445-6833	100000000000000000000000000000000000000	MIRO COMPUTER PRODUCT		+49-531-2113-10
130	AMERICAN POWER	64A-B		10000	FAST SECURITY AG	237	+49-89-894221-20	102-100	AG	01	. 40 007 21 10/10
ALC: N	CONVERSION							740-741		CV	+886-2-501-4265*
30	AMERICAN POWER	65	800-800-4APC	184	FINSON	170	+39-2-6698-7036	CONT. (TOTAL)	7311000		
30	CONVERSION	65	DPT.A2	746-747	FIRST INTERNATIONAL	48IS 2	+886-2-718-2782**	742-743		48IS 24	+886-2-501-4265*
77.70	APPRO INTERNATIONAL INC	001			COMPUTER				MOTOROLA	96-97	
77-78			800-927-5464	241-242	FIRST SOURCE INT'L	210	714-448-7750		-SEMICONDUCTOR		
219	ARTECON	155	800-872-2783	729-730	FISKARS POWERS	48IS 21	+358 0 452661		MOTOROLA	98-99	
744-745	ATRIE	48IS 18	+886-2-999-4960**	Water Control	SYSTEMS				-SEMICONDUCTOR		
207-208	AUTONOMY SYSTEMS	128	+4401223421583**	255	FOREFRONT/ALLMICRO INC	201	800-653-4933	187-188	MRT	166	+47 63 89 63 00
	AVIATION WEEK	142-143	609-426-5526		0				NI		
750-751	AVISION	4815 27	886-3-577-7017**		G				IN		
82-83	AXIOM TECHNOLOGY	221	909-464-1881	104	GAGE APPLIED SCIENCES!	NC 222	800-567-GAGE	106	NATIONALINSTRUMENTS	223	800-433-3488
							ext 3425	714	NATIONALINSTRUMENTS	48IS 36	800-433-3488
721-722	AXIS COMMUNICATIONS	11	+46 46 270 18 00	230-231	GEOSAT	164	800-772-3667		NET2PHONE	215	201-928-2990
	R			221	GLOBETROTTERSOFTWARE		408-370-2800	761.769	NOKIA MOBILE PHONES		+358 10 505 5862*
100 100	DEST DOWNED	400	000 505 5000	1555 Oc				100000000000000000000000000000000000000			
	BESTPOWER	103	608-565-7200	91-92	GRANITEDIGITAL	223	510-471-6442	20000000	NOVOTEC	95	+49-89-35629770
	BEST POWER	107	608-565-7200	710	GREYMATTERLID		+44-(0)1364-654200**	222	NRW	147	+49-211-837-2751**
136-137	BESTPOWER	111	608-565-7200	754-755	GVC	48IS 37	+886-2-704-0338**	154	NSTL	243	610-941-9600
450	BIX	246	800-695-4775		П			209-210	NSTOR CORPORATION	23	800-724-3511
138	BORLAND INTERNATIONAL	37	800-336-6464		11			metrosam	0		
	BYTE	174	603-924-2663	117-118	HIWAYTECHNOLOGIES	226	800-339-HWAY		U		
	BYTE	193		725-726	HYPERSYSTEMS	48IS 40	+39-11-434-2350	121	OBJECT MANAGEMENT	227	800-6789-OML
			603-924-2663		and the second second				LABORATORY		
	BYTE BACK ISSUES	87	603-924-9281		1			719	ONTIMEMARKETING	4815 28	+49-40-437472
•	BYTE BACK ISSUES	218	603-924-9281	84-85	ICPACQUIRE	221	888-618-6188		OSBORNE MCGRAW-HILL:	238-239	800-822-8158
•	BYTE CUSTOMER SERVICE	218	+353-91-752-792		IDTINTERNET	215	800-689-9438		D		
•	BYTE EURODECK	61	603-924-2533	733	INFOCUS	48IS 13	+31-2356-23200		P		
•	BYTE FIELD SALES	48IS 38	+353-91-752-792	723-724	INNOVATIVE SOFTWARE	48IS 40	+49-69-236929	763-764	PANDA SOFTWARE	4815 20	+34-1-3013015
	BYTE MOVING?	192		202	INNOVUS MULTIMEDIA	131	888-301-7728		INTERNAIONAL		
	BYTEON CD ROM	245	800-924-6621	100				715	PERSOFTING	48159	800-368-5283
			000-924-0021	216	INTEGRIXING	157	800-300-8288	760	PHILIPS SEMI-CONDUCTOR	S 8-9	+31 40 272 4825**
	BYTE PUBL STATEMENT	231		S.com	INTELCORPORATION	24-25	800-538-3373		PHILIPS BUSINESS	118	+88634549566**
	BYTEREPRINTS	70	603-924-2525	89-90	INTERLOGICINDUSTRIES	221	516-420-8111	200 200	ELECTRONICS	110	100004040000
•	BYTE SUB MESSAGE	218		112-113	INTERNET SHOPPER	226	+44-(0)181 673 2149*	155 150	PINNACLEMICRO	7	714-789-3000
	BYTEWEBSITE	237	http://www.byte.com/	105	IOTECH	222	216-439-4091	100000000000000000000000000000000000000			
	BYTEWEBSITE	48IS 35	http://www.byte.com/		IOMEGA	55	888-2-IOMEGA	157	PKWAREINC	189	414-354-8699
	C					-	ext j22	95330	POLYWELL SYSTEMS	205	800-300-7659
				179-180	IQ SOFTWARE	12-13	800-458-0386	172	POWERSOFT C++	85	800-265-4555
94-95	CAMELEON TECHNOLOGY	NC 223	800-440-7466	1000				178	POWERSOFT OPTIMA	31	800-395-3525
223	CARDIFF SOFTWARE	165	800-659-8755		J			194-195	PRINCETON GRAPHIC SYSTE	EMS 52	714-751-8405
196	CETRA	172			JAMECO ELECTRONICS	209	800-831-4242	The second second	PROXIMA CORPORATION	169	800-447-7692
					JENSEN TOOLS	223			PROMINACON CHANGIN	100	ext 443
	CHICONYELECTRONICS	48IS 15	Contract Laboratory	(A)			800-426-1194		DDOVIMA CODDODATION	474	
213	CLEAR SOFTWARE	186	617-965-6755	102	JK MICROSYSTEMS	224	510-236-1151		PROXIMA CORPORATION	171	800-447-7692 ext 443
115-116	CLOUCONSULTING	226	800-226-0640		K			*	DDOVIMA CODDODATION	4-10	
769-770	CMDTECHNOLOGY	48156	714-454-0800	70			200 505 0540	5	PROXIMA CORPORATION	173	800-447-7692
	COMPEXING	43	714-630-7302		KILA	221	800-505-6749	470	ppownii oogganing		ext 443
235		196-197	800-959-4CDW		KINGSTON CPU UPGRADE	66	714-437-3334	176-177	PROXIMA CORPORATION	175	800-447-7692
	WAREHOUSE	190-19/	BUU-959-4CDW	147-148	KINGSTON STORAGE	39	714-435-2600		-		ext 443
703	COMPUTER QUICK	48IS 26	415-861-8330	748-749	KUO FENG CORPORATION	4815 19	+886-2-754-2829**		()		
				734-735	KYOCERA	45	+49-2159-918-108**	2022	CLUM ENTER DO	100	
36	COMPUTERLANE UNLIMITED		800-526-3482		1	10			QNX EXPLR2	18	800-862-1883
15	COMTROL CORP	138	800-926-6876					158	QNX SOFTWARE SYSTEMS L	10 183	800-656-0566
52-253	CONSANINC	198	800-221-6732	256-257	LATRADE	200	800-433-3726	200			ext 102
	CONSUMERINFORMATION	216		100000000000000000000000000000000000000	LAHEY COMPUTER SYSTEM		800-548-4778	103	QUALSTAR CORP	225	800-468-0680
	CENTER							61-62	QUATECHING	219	800-553-1170
	COPIA INTERNATIONAL LTD	22	800-689-8898		LANSOURCE	48IS 16	416-535-3555		D		
20					TECHNOLOGY				K		
39	COREL	109	613-728-0826	1	M			88	RACKMASTER	221	800-480-4384
Sepanne .	Anna Carlos de C	CANTO	ext 3080				17444141414141		RAD DATA COMMUNICATION		+972-3-645-8107
010 010	CYBEX COMPUTER	199	205-430-4000	123.75	MAGIC/MSE	48IS 11	+972-3-538-9292	NEW CONTRACTOR OF COMMENTS			
39-240	PRODUCTS CORP				MAINPOWER	4815 30	+886-2-918-0657**	CARL BUILDING	RAIDTEC CORPORATION	217	770-664-6066
			005 400 4000	The same of the same of	ELECTRONICS			717-718	RAIMACORP	4815 14	206-557-0200
	CYBEX COMPUTER	206	205-430-4000	1 57							
		206	205-430-4000	97	MCGRAW HILL ON LINE	48IS 29		160	RAINBOW TECHNOLOGIES	58	714-450-7300

FREE PRODUCT INFORMATION

BYTE Advertisers Deliver the Information You Need - FA

NOUIRE BY MAIL

nter your name nd address at right. hen circle the nquiry numbers hat correspond to hose on the dvertisement or YTE article, and nail this attached ard.

NOUIRE BY FAX

Enter the nformation as lescribed above. hen fax this ard to:

NQUIRE ON THE INTERNET Access BYTE's nome page at: www.byte.com

and click on Free Product Information. Follow the nstructions on-line.



YES! I want FREE product information from the following advertisers

Fill out this coupon carefully. Please print.

Name First	Last	
Title		
Company		
Address		
City		
State	Zip	
Phone		

- A. My company profile is best described as: (check one) ☐ Corporate end user
 - ☐ Computer/communications manufacturer
 - 3 Reseller/distributor/OEM/integrator/consultant
 - 4 □ Other (please describe):
- B. My job function is best described as: (check one)
- Company Management
- ☐ IS/MIS/IT Management
- ☐ Systems Engineering/Integration
- ☐ Departmental Management (non-IS/MIS)
- ☐ Technical Services Support
- 10 Other (please describe):
- C. My responsibilities require that I be involved with the following nneration system environments: (check all that apply)
- 12 D 0S/2
- 13 ☐ Mac/OS
- 14 ITI UNIX (anv. including Solaris)
- 15 □ Windows
- 16 ☐ Windows/NT
- 17 □ NetWare

18 ☐ Other (please describe):

- D. Please indicate which specific fields of interest are important to you: (check all that apply)
 - 19 Mobile Computing
 - 20 Application development
 - 21 Client/Server
 - 22 ☐ Internet/no-line
- 23 T Video Conferencing
- 25 PC Telephony
- F. Do you influence the nurchase of the following products or services for your organization? (check all that apply)
 - 26 Computers/peripherals
- 27 Software applications
- 28 Pemote/wireless communications
- 29 I LAN hardware or software
- 30 Internetworking hardware, software, or services

November 1996

90 97 99

Valid until January 31, 1997

Advertiser Inquiry Numbers

739 756 773 790 740 741 757 758 732 733 734 735 736 749 750 751 752 753 738 755 737 742 743 759 760 768 769 770 785 786 787 771 788 772 789 774 775 791 792 776 777 793 794 778 795 779 780 796 797 764 766 767 781 783 784 798 815 799 800 801 802 803 804 805 806 816 817 818 819 820 821 822 823 807 824 808 809 810 811 825 826 827 828 812 813 814 830 831 833 834 835 836 837 838 839 840 850 851 852 853 854 855 856 857 841 842 843 844 845 858 859 860 861 862 846 849 863 868 869 870 871 872 873 874 875 876 877 878 879 890 891 883 884 885 886 887 888 889 892 893 894 895 896 897 898 899 904 905 906 908 910 911 912 918 919 920 921 922 923 924 925 926 927 928 929 930 931 932 933 936 937 938 939 940 941 942 943 944 945 946 952 953 954 955 956 957 958 959 969 970 971 972 973 974 975 960 961 962 963 964 965 966 967

Editorial Inquiry Numbers

976 977 978 979 980 981 982 983 984 985 986 987 988 989 990 991 992 993 994 995 996 997 998 999 1000 1001 1002 1003 1004 1005 1006 1007 1008 1009 1010 1011 1012 1013 1014 1015 1016 1017 1018 1019 1020 1021 1022 1023 1024 1025 1026 1027 1028 1029 1030 1031 1032 1033 1034 1035 1036 1037 1038 1039 1040 1041 1042 1043 1044 1045 1046 1047 1048 1049 1050 1051 1052 1053 1054 1055 1056 1057 1061 1062 1063 1064 1065 1066 1067 1068 1069 1070 1071 1072 1073 1074 1075 1076 1077 1078 1079 1080 1081 1082 1083 1084 1085 1086 1087 1088 1089 1090 1091 1082 1083 1084 1095 1096 1097 1098 1099 1100 1101 1102 1103 1104 1105 1106 1107 1108 1109 1110 1111 1112 1113 1114 1115 1116 1117 1118 1119 1120 1121 1122 1123 1124 1125 1126 1127 1128 1129 1130 1131 1132 1133 1134 1135 1136 1137 1138 1139 1140 1141 1142 1143 1144 1145 1146 1147 1148 1149 1150 1151 1152 1153 1154 1155 1156 1157 1158 1159 1160 1161 1162 163 1164 1165 1166 1167 1168 1169 1170 1171 1172 1173 1174 1175 1176 1177 1178 1179 1180 1181 1182 1183 1184 1185 1186 1187 1188 1189 1190 1191 1192 1193 1194 1195 1196 1197 1198 1199 1200 1201 1202 1203 1204 1205 1206 1207 1208 1209 1210 1211 1212 1213 1214 1215 1216 1217 1218 1219 1220 1221 1222 1223 1224 1225 1226 1227 1228 1229 1230 1231 1232 1233 1234 1235 1236 1237 1238 1239 1240 1241 1242 1243 1244 1245 1246 1247 1248 1249 1250 1251 1252 1253 1254 1255 1256 1257 1258 1259 1260 1261 1262 1263 1264 1265 1266 1267 1268 1269 1270 1271 1272 1273 1274 1275 1276 1277 1278 1279 1280 1281

0

0

P

S

Si

S U

U

W

Recruitment

Miscellaneous

Product Category Information

To receive information for an entire category, circle the appropriate number in box above.

ardware	
ccessories/Supplies	1
dd-in Boards	2
ar Coding	3
communications/Networking	4
Computer Systems	5
ata Acquisition	6
lagnostic Equipment	53
isks & Optical Drives	7
iskettes/Duplicators	8
ax Boards/Machines	9

Graphics Tablets/Mice/ 10 Pen Input 11 Keyboards LAN Hardware Laptops & Notebooks 13 14 Mail Order Memory/Chips/Upgrades 15 Miscellaneous Hardware 16 Modems/Multiplexors Monitors & Terminals 18 Multimedia/CD-ROM 19 **PCMCIA** Printers/Plotters 20 Programmable Hardware RAID Drive Arrays SCSI/Peripheral Interfaces 59 Scanners/OCR/Digitizers

Security

Tape Drives	23
UPS/Power Management	24
Voice Technology	55
Software	
Business	25
CAD/CAM	26
Communications/Networking	27
Data Acquisition	28
Database	29
Educational	30
Engineering/Scientific	31
Entertainment	32
Graphics	33
Macintosh	34
Mail Order	35
Mathematical/Statistical	36
Miscellaneous Software	37

10.10.0	(984)
n-Line Services	38
perating Systems	39
S/2	54
ogramming Languages/	
Tools	40
ecurity	41
nareware	42
oftware Duplication	43
oreadsheets	44
NIX	45
filities	46
indows	47
ord Processing	48
eneral	
noks/Publications	49

50

FREE PRODUCT INFORMATION

BYTE Advertisers Deliver the Information You Need - FAST!

P.O. BOX 66 HOUNSLOW

FRG/BOS/700252/MO1

TW5 9RT

A Division of The McGraw-Hill Companies

FAST:

INQUIRE BY MAIL Enter your name and address at right. Then circle the inquiry numbers that correspond to those on the advertisement or BYTE article, and mail this attached card.

FASTER

INQUIRE BY FAX

Enter the information as described above. then fax this card to:

FASTEST:

INQUIRE ON

THE INTERNET Access BYTE's home page at: www.byte.com and click on Free Product Information. Follow the instructions on-line.

PLACE POSTAGE HERE



ADVERTISER CONTACT INFORMATION

INQUIR	Y NO.	PAGENO	PHONE NO.	INQUIR	Y NO.	PAGENO	PHONE NO.	INQUIR	r NO.	PAGENO	. PHONE NO.
67-68	RCI	220	800-RCI-8090	250-251	STARTECH INTERNATIONAL		619-278-2600		П		
75 70	DECORTECINO		ext 71	164	STATSOFT	81	918-749-1119		U	- 112	
75-76	RECORTECINC	222	888-RECORTEC		T			86-87	U.S.LOGIC	222	800-777-4875
248-249	ROSE ELECTRONICS	204	800-333-9343	1200					V		
161-162	ROSSTECHNOLOGYINC	46-47	800-ROSS-YES	752-753	TAINET COMMUNICATION SYSTEM	48IS 22	+886-2-658-3232	262-263	VCOMMUNICATIONS	204	800-648-8266
	5			65	TALKING TECHNOLOGY INC	220	800-945-4884	63	VIDEXING	219	541-758-0521
183	SAG ELECTRONICS	21	508-682-0055	98	TAPEDISK CORPORATION	224	715-235-3388	170-171	VIEWSONIC	62	800-888-8583
114	SCITECH INTERNATIONAL	226	800-898-9044	264-265	TEKNOR INDUSTRIAL	215	800-387-4222	211-212	VOCALTEC	194	800-899-3942
227-228	SEH COMPUTERTECHNIK	161	+49-521-94226-0		COMPUTERS			2001/00/00	1A/	1477.51	STORY THE
	GMBH			165	TEKTRONIX	69	800-835-6100		W		
163	SILICON GRAPHICS	34-35	800-636-8184				1314		WALKER, RICHER & QUINN	179	206-217-7100
			D440		TELE.COM	16-17		225-226	WIBU SYSTEMS AG	160 -	+49-721-93172-22**
79	SILICONRAX	222	800-700-8560		TELE.COM	213		1000000 N.S.	7		
96-97	SLIGER DESIGNS	224	702-356-5595	101	TERNING	224	916-758-0110		L		
107	SOFTWARE SECURITY	225	203-656-3932*		THE COMPUTER MUSEUM	214		100	Z-WORLD ENGINEERING	225	916-757-3737
260-261	SOFTWAY SYSTEMS	217	415-896-0708	166	TOSHIBA AMERICA INC	28-29	800-457-7777				
70	STARTECH COMPUTER	219	800-265-1844	167-168	TRAVELING SOFTWARE	127	800-224-7704				
	PRODUCTS		ext 231	74	TRI VALLEY TECHNOLOGY II	VC 222	510-447-2030				

BYTE ADVERTISING SALES STAFF

John M. Griffin, Vice President, Publisher, One Phoenix Mill Lane, Peterborough, NH 03458, Tel: (603) 924-2615, Fax: (603) 924-7620, jgriffin@mcgraw-hill.com

NEW ENGLAND

CT, MA, ME, NH, NY, RI, VT,
Ontario, Canada, Eastern Canada
John Ferraro (617) 860-6221,
(212) 512-2555
jferraro@mcgraw-hill.com
Jeanne Beeson (617) 860-6349
jbeeson@mcgraw-hill.com
The McGraw-Hill Companies
24 Hartwell Avenue
Lexington, MA 02173
FAX: (617) 860-6307

NEW YORK

NY Metro, NJ Michael Feinberg (212) 512-4811 feinberg@mcgraw-hill.com Jill Pollak (212) 512-3585 jpollak@mcgraw-hill.com The McGraw-Hill Companies 1221 Avenue of Americas—28th Floor New York, NY 10020 FAX: (212) 512-2075

SOUTHWEST, ROCKY MOUNTAIN

AL, AR, LA, MS, OK, TN, TX
Bert Panganiban (214) 688–5165
bertpang@mcgraw-hill.com
Brian Higgins (603) 924–2596
bhiggins@mcgraw-hill.com
The McGraw-Hill Companies
Mockingbird Towers
Ste. 1104E
1341 W. Mockingbird Lane
Dallas, TX 75247-4943
FAX: (214) 688–5167

MID ATLANTIC-SOUTHEAST NEW MEDIA/ONLINE PRODUCTS

DC, DE, FL, GA, KY, MD, NC, PA, SC, VA, WV Neil Helms (770) 242–6298 nhelms@mcgraw-hill.com Paul Franchak (614) 899–4912 franchak@mcgraw-hill.com The McGraw-Hill Companies 6050 Peachtree Pkwy. Suite 340–191 Norcross, GA 30092 FAX: (770) 409–9622

CENTRAL U.S.

LA, IL, IN, KS, MI, MN, MO, ND, NE, OH, SD, WI
Lori Silverstein (614) 899-4908
lorisf@mcgraw-hill.com
Paul Franchak (614) 899-4912
franchak@mcgraw-hill.com
The McGraw-Hill Companies
921 Eastwind Drive, Suite 118
Westerville, OH 43081
FAX: (614) 899-4999

NORTH PACIFIC

AK, Northern CA, HI, ID, MT, OR, Silicon Valley, UT, WA, WY, Western Canada Roy J. Kops (415) 513–6861 rkops@mcgraw-hill.com Lisa Farrell (415) 513–6862 lfarrell@mcgraw-hill.com The McGraw-Hill Companies 1900 O'Farrell Street, Suite 200 San Mateo, CA 94403 FAX: (415) 513–6867

SOUTH PACIFIC

AZ, Southern CA, CO, NM, NV Beth Dudas (714) 753-8140 bdudas@mcgraw-hill.com Geanette Perez (714) 753-8140 gperez@mcgraw-hill.com The McGraw-Hill Companies 15635 Alton Pkwy., Suite 290 Irvine, CA 92718 FAX: (714) 753-8147

PETERBOROUGH, NH OFFICE:

Sales FAX: 603-924-2683 Advertising FAX: 603-924-7507

BUYERS MART

Mark Stone (603) 924–2533 stonem@mcgraw-hill.com BYTE One Phoenix Mill Lane Peterborough, NH 03458

RYTE Deck

Brian Higgins (603) 924-2596 bhiggins@mcgraw-hill.com BYTE One Phoenix Mill Lane Peterborough, NH 03458

FURO-DECK

Mark Stone (603) 924–2533 stonem@mcgraw-hill.com BYTE One Phoenix Mill Lane Peterborough, NH 03458

INTERNATIONAL ADVERTISING SALES STAFF

L. Bradley Browne, International Sales Director, One Phoenix Mill Lane, Peterborough, NH 03458, Tel: (603) 924–2501, Fax: (603) 924–2602, bbrowne@mcgraw-hill.com

UNITED KINGDOM, BENELUX

Jonathan McGowan jonmcgow@mcgraw-hill.com The McGraw-Hill Companies 34 Dover St. London W1X 4BR England Tel: +44 171 495 6781 FAX: +44 171 4956734

ISRAEL

Dan Aronovic
rhodanny@actcom.co.il
DARA International
41 Ravutski
Ra'anana 43220
Israel
Tel: +972-9-7419544
FAX: +972-9-7481934

KOREA

Young-Seoh Chinn JES Media International 6th Fl., Donghye Bldg. 47-16, Myungil-Dong Kangdong-Gu Seoul 134-070, Korea Tel: +82-2-4813411 FAX: +82-4813414

ITALY, FRANCE, SPAIN, PORTUGAL, SCANDINAVIA

Zena Coupé, Amanda Blaskett 101645.1710@compuserve.com A-Z International Sales Ltd. 70 Chalk Farm Road London NW1 8AN England Tel: +44 171 2843171 FAX: +44 171 2843174

GERMANY, SWITZERLAND, AUSTRIA

Jürgen Heise
jheise@mcgraw-hill.com
The McGraw-Hill Companies
Emil von Behring Strasse 2
D-60439 Frankfurt
Germany
Tel: +49 69 5801 140
FAX: +49 69 5801 145

JAPAN

Hirokazu Morita Japanese Advertising Communications, Inc. Three Star Building 3-10-3 Kanda Jimbocho Chiyoda-ku, Tokyo 101 Japan Tel: +81 3 3261 4591 FAX: +81 3 3261 6126

BYTE ASIA-PACIFIC AUSTRALIA, HONG KONG, INDIA,

INDONESIA, KOREA, MALAYSIA, PAKISTAN, PHILIPPINES, OTHER ASIA AND PACIFIC COUNTRIES, SINGAPORE, TAIWAN Weiyee In weiin@mcgraw-hill.com Jennifer Chen jennchen@mcgraw-hill.com #305 Nanking East Road, Section 3, 10th floor Taipei, Taiwan, R.O.C. Tel: +886-2-715-2205 FAX: +886-2-715-2342

Subscription Customer Service U.S. 1-800-232-2983

Outside U.S. +1-609-426-7676

For a New Subscription

U.S. 1-800-257-9402 Outside U.S. +1-609-426-5526

INDEX TO ADVERTISED PRODUCTS

For free product information from individual advertisers, circle the corresponding inquiry numbers on the response card!

To receive information for an entire product category, circle the category number on the response card!

CATEGOR INQUIRY I		PAGE NO.	INQUIRY NO		AGE NO.	INQUIRY N		AGE NO.
1 A A	DDIMADE		174	MICRON ELECTRONICS	56-57	*	MICRO-INTERNATIONALINC	224
HA	RDWARE		175	MICRONELECTRONICS	74-75	740-741	MITAC	C
-		-		MICROWAY	100	742-743	MITAC	48IS 2
1	ACCESSORIES/SUPPLIES		740-741	MITAC	CV	166	TOSHIBA AMERICA INC	28-2
08-109	JENSENTOOLS	223	742-743	MITAC	48IS 24	167-168	TRAVELING SOFTWARE	12
2	ADD-IN BOARDS		266-267	NOVOTEC	95	612	WINBOOK COMPUTER CORPORATION	N 1
32-83	AXIOMTECHNOLOGY	221	154	NSTL	243	613	WINBOOK COMPUTER CORPORATIO	N 4
4-95	CAMELEON TECHNOLOGY INC	223	247	POLYWELL SYSTEMS	205	14	MAIL ORDER	
15	COMTROL CORP	138	88	RACKMASTER	221	234		20
04-605	DARIM	104NA2	220	RAVE COMPUTER ASSOCIATES	148		ALTEX COMPUTERS & ELECTRONICS	
90-191	DEXON SYSTEMS LTD	22	75-76	RECORTECINC	222	235	COMPUTER DISCOUNT WAREHOUSE	
46-747	FIRST INTERNATIONAL COMPUTER	48152	230-231	RENEGADE SYSTEMS	164	050 054	JAMECO ELECTRONICS STARTECH INTERNATIONAL	20
10 141	MICROWAY	100	183	SAG ELECTRONICS	21	250-251		
1-62	QUATECHING	219	163	SILICON GRAPHICS	34-35	15	MEMORY/CHIPS/UPGRA	DES
6-87	U.S.LOGIC	222	79	SILICONRAX	222	94-95	CAMELEON TECHNOLOGY INC	22
		262	264-265	TEKNOR INDUSTRIAL COMPUTERS	215	241-242	FIRST SOURCE INT'L	21
3	BAR CODING		74	TRIVALLEY TECHNOLOGY INC	222	145-146	KINGSTONTECHNOLOGY	6
33	VIDEXING	219	86-87	U.S.LOGIC	222	256-257	LATRADE	20
1	COMMUNICATIONS/		0000000			760	PHILIPS SEMI-CONDUCTORS	8-
	NETWORKING		6	DATA ACQUISITION		161-162	ROSS TECHNOLOGY INC	46-4
67-768	ACCTON TECHNOLOGY	48IS 23	82-83	AXIOMTECHNOLOGY	221	16	MISCELLANEOUS HARDY	MARE
234	ALTEX COMPUTERS & ELECTRONICS		104	GAGE APPLIED SCIENCES INC	222	110-111	AEHOMECORPORATION	22
34	AMERICAN ADVANTECH	219	105	IOTECH	222		MOTOROLA-SEMICONDUCTOR	96-9
744-745	ATRIE	48IS 18	714	NATIONALINSTRUMENTS	48IS 36			98-9
721-722	AXIS COMMUNICATIONS	11	106	NATIONALINSTRUMENTS	223	-	MOTOROLA-SEMICONDUCTOR	
602	BAYNETWORKS	70	61-62	QUATECHING	219	96-97	SLIGER DESIGNS	22
701-702	COMPEXING	43	86-87	U.S.LOGIC	222	17	MODEMS & MULTIPLEXO	ORS
Sales and the sales and the sales are also as a sales are a sales		208	53	DIAGNOSTIC EQUIPMEN	T	767-768	ACCTON TECHNOLOGY	48152
236	COMPUTERLANE UNLIMITED		255	FOREFRONT/ALLMICRO INC	201	744-745	ATRIE	48IS 1
215	COMTROL CORP	138	108-109	JENSEN TOOLS	223	603	CARDINALTECHNOLOGIES	104NA
736-737	DBTEL	48IS 39	224	MICRO 2000	158-159	736-737	DBTEL	48153
738-739	E-TECH	48IS 31	1972-023		100 100	738-739	E-TECH	48IS 3
216	INTEGRIXING	157	7	DISK & OPTICAL DRIVES		610-611	NEWCOM	104NA
108-109	JENSEN TOOLS	223	219	ARTECON	155	752-753	TAINET COMMUNICATION SYSTEM	48152
66	MINICOM/CLASSNET VIDEO	219	252-253	CONSANINC	198	10	MONITORE & TERMINAL	
761-762	NOKIA MOBILE PHONES	48IS 5	91-92	GRANITE DIGITAL	223	18	MONITORS & TERMINAL	
716	RAD DATA COMMUNICATION LTD	83		IOMEGA	55	754-755	GVC	48153
67-68	RCI	220	147-148	KINGSTON TECHNOLOGY	39	748-749	KUO FENG CORPORATION	48IS 1
248-249	ROSEELECTRONICS	204	243-244	MICRO SOLUTIONS COMP PROD	203	740-741	MITAC	C
70	STARTECH COMPUTER PRODUCTS	219	245-246	MICRO SOLUTIONS COMP PROD	207	742-743	MITAC	4815 2
752-753	TAINET COMMUNICATION SYSTEM	4815 22	155-156	PINNACLE MICRO	7	205-206	PHILIPS BUSINESS ELECTRONICS	11
65	TALKING TECHNOLOGY INC	220	250-251	STARTECH INTERNATIONAL	212	194-195	PRINCETON GRAPHIC SYSTEMS	5
5	COMPUTER SYSTEMS		9	FAX BOARDS/MACHINES	5	170-171	VIEWSONIC	6
80-81	ACI	220	93	ADVANCED IMAGE COMMUNICATION		19	MULTIMEDIA/CD-ROM	
	ACORN COMPUTER GROUP	KEY	610-611	NEWCOM	104NA7	252-253	CONSANINC	19
72	AMERICAN ADVANTECH	220	200000	a Danage Age of the Control of the C	TOTHER	604-605	DARIM	104NA
71	AMERICAN ADVANTECH	220	12	LAN HARDWARE		736-737	DBTEL	48153
77-78	APPRO INTERNATIONAL INC	221	767-768	ACCTON TECHNOLOGY	48IS 23	185-186	ELEKTROSON BV	19
82-83	AXIOMTECHNOLOGY	221	110-111	AE HOME CORPORATION	225	733	INFOCUS	4815 1
758-759	CHICONY ELECTRONICS CO	48IS 15	215	COMTROL CORP	138		MCGRAW HILL ON LINE	48IS 2
30 100	COMPAQ	8-9	704-705	CYBEX COMPUTER PRODUCTS COR	P CVI	99	MICROPATENT	22
	DELL COMPUTER CORP	CV-CVI	239-240	CYBEX COMPUTER PRODUCTS COR	P 199	192-193	MIRO COMPUTER PRODUCTS AG	5
			237-238	CYBEX COMPUTER PRODUCTS COR	P 206	+	PROXIMA CORPORATION	16
	DELL COMPUTER CORP	CVII-CVIII	241-242	FIRST SOURCE INT'L	210		PROXIMA CORPORATION	17
	DELL COMPUTER CORP	40-41	720	LANSOURCETECHNOLOGY	4815 16	•	PROXIMA CORPORATION	17
40 4-0	DELL COMPUTER CORP	104NA 1	183	SAG ELECTRONICS	21	176-177		17
42-143	DTK COMPUTERING	88	227-228	SEH COMPUTERTECHNIK GMBH	161		PROXIMA CORPORATION	
746-747	FIRST INTERNATIONAL COMPUTER	4815 2	-VALUE (NO.)			163	SILICON GRAPHICS	34-3
34-85	ICPACQUIRE	221	13	LAPTOPS & NOTEBOOKS		98	TAPEDISK CORPORATION	22
216	INTEGRIXING	157	758-759	CHICONY ELECTRONICS CO	48IS 15	57	PCMCIA	
	INTEL CORPORATION	24-25	236	COMPUTERLANE UNLIMITED	208	187-188	MRT	16
89-90	INTERLOGICINDUSTRIES	221	141	DOLCH COMPUTER SYSTEMS	117	Course in distance	DDINITEDS/DI OTTEDS	
73	KILA	221	746-747	FIRST INTERNATIONAL COMPUTER	48IS 2	20	PRINTERS/PLOTTERS	48152
173	MICRONELECTRONICS	CII-1	733	INFOCUS	48IS 13	750-751	AVISION	46132

INDEX TO ADVERTISED PRODUCTS

NOUIRY		PAGE NO.	INQUIRY N		PAGE NO.	INQUIRY N		GE NO.
34-735	KYOCERA	45	167-168	TRAVELING SOFTWARE	127	121	OBJECT MANAGEMENT LABORATORY	22
27-228	SEH COMPUTERTECHNIK GMBH	161	211-212	VOCALTEC	194	719	ON TIME MARKETING	48152
65	TEKTRONIX	69	*	WALKER, RICHER & QUINN	179	172	POWERSOFTC++	8
1	PROGRAMMABLE HARD	MADE	29	DATABASE		178	POWERSOFT OPTIMA	3
27-128	- A Section of Contract the Contract Co	-		A STATE OF THE PARTY OF THE PAR	107	717-718	RAIMA CORP	48IS 1
max bottom	ALADDIN SOFTWARE SECURITY INC	190	144	FAIRCOM CORPORATION	187		WALKER, RICHER & QUINN	17
08-709	FAST SECURITY AG	237	725-726	HYPERSYSTEMS	4815 40	225-226	WIBU SYSTEMS AG	16
02	JKMICROSYSTEMS	224	179-180	IQSOFTWARE	12-13	CONTRACTOR OF THE PARTY		,,,
01	TERNING	224	712-713	MAGIC/MSE	48IS 11	41	SECURITY	
00	Z-WORLD ENGINEERING	225	30	EDUCATIONAL		125-126	ALADDIN SOFTWARE SECURITY INC	7
6	RAID DRIVE ARRAYS		115-116	CLOU CONSULTING	226	127-128	ALADDIN SOFTWARE SECURITY INC	19
10-111	AEHOMECORPORATION	225	110-110			122	DUNN SYSTEMS	22
	ARTECON		31	ENGINEERING/SCIENTI	FIC	706-707	EUTRON	4815
19		155	115-116	CLOUCONSULTING	226	708-709	FAST SECURITY AG	23
69-770	CMD TECHNOLOGY	48IS 6	719	ON TIME MARKETING	4815 28	763-764	PANDA SOFTWARE INTERNAIONAL	4815 2
40	DISTRIBUTED PROCESSING TECH	93	114	SCITECH INTERNATIONAL	226	160	RAINBOW TECHNOLOGIES	5
16	INTEGRIXING	157	22	CDARINGS		225-226	WIBU SYSTEMS AG	16
66-267	NOVOTEC	95	33	GRAPHICS		223-226	WIBUSTSTEWS AG	10
09-210	NSTOR CORPORATION	23	213	CLEAR SOFTWARE	186	45	UNIX	
58-259	RAIDTEC CORPORATION	217	139	COREL	109		COPIA INTERNATIONAL LTD	2
83	SAGELECTRONICS	21	190-191	DEXON SYSTEMS LTD	22	144	FAIRCOM CORPORATION	18
		EDC	(1.4°)	MICROGRAFX	73	260-261	SOFTWAY SYSTEMS	21
2	SCANNERS/OCR/DIGITIZ		229	MIPS DATALINE AMERICA INC	165		WALKER, RICHER & QUINN	17
50-751	AVISION	48IS 27		PROXIMA CORPORATION	169	10.15		
9	SCSI		*	PROXIMA CORPORATION	171	46	UTILITIES	
69-770	CMD TECHNOLOGY	48IS 6		PROXIMA CORPORATION	173	255	FOREFRONT/ALLMICRO INC	20
		10.00	176-177	PROXIMA CORPORATION	175	224	MICRO 2000	158-15
52	SECURITY			No. of the Control of	175	157	PKWAREINC	18
25-126	ALADDIN SOFTWARE SECURITY INC	78	35	MAIL ORDER		98	TAPEDISK CORPORATION	22
27-128	ALADDIN SOFTWARE SECURITY INC	190	235	COMPUTER DISCOUNT WAREHOU	SE 196-197	167-168	TRAVELING SOFTWARE	12
08-709	FAST SECURITY AG	237	703	COMPUTER QUICK	48IS 26	100 0000		
60	RAINBOW TECHNOLOGIES	58	710	GREY MATTER LTD	48IS 32	47	WINDOWS	
07	SOFTWARE SECURITY	225	20	MANTHEN ANTION LICTATI	CTICAL	*	COPIA INTERNATIONAL LTD	2
25-226	WIBU SYSTEMS AG	160	36	MATHEMATICAL/STATI		98	TAPEDISK CORPORATION	22
			115-116	CLOU CONSULTING	226		VISIO CORPORATION	6
23	TAPE DRIVES		153	MINITABING	168	612	WINBOOK COMPUTER CORPORATION	N 1
65-766	EXABYTE EUROPE	48IS 29	164	STATSOFT	81	613	WINBOOK COMPUTER CORPORATION	N 4
43-244	MICRO SOLUTIONS COMPPROD	203	37	MISCELLANEOUS SOFT	WARE	40	WORD BROCESSING/DTB	
45-246	MICRO SOLUTIONS COMP PROD	207	184	FINSON		48	WORD PROCESSING/DTP	
03	QUALSTAR CORP	225	184	HNSON	170	214	ADOBE SYSTEMS INC	15
	LIDE POWED MANAGEMA	CALL	38	ON-LINE SERVICES		CE	MEDAI	
24	UPS/POWER MANAGEM	and the same of th	232-233	AIRMEDIA	162-163	UE	NERAL	
29	AMERICAN POWER CONVERSION	33		AMERICA ONLINE	OUTSERT	-		-
30	AMERICAN POWER CONVERSION	65	207-208	AUTONOMY SYSTEMS	128	49	BOOKS/PUBLICATIONS	
32-133	BESTPOWER	103	450	BIX	246	*	AVIATION WEEK	142-14
34-135	BEST POWER	107	117-118	HIWAYTECHNOLOGIES	226	*.	BYTE ON CD ROM	24
36-137	BESTPOWER	111	117-110				DATA COMMUNICATIONS	40-4
29-730	FISKARS POWERS SYSTEMS	48IS 21		IDTINTERNET	215		MICROSOFT PRESSINC	9
56-757	MAINPOWER ELECTRONICS	48IS 30	-	MICROSOFT CORPORATION	2-3		OSBORNEMCGRAW-HILL	238-23
			39	OPERATING SYSTEMS			TELE.COM	16-1
55	VOICE TECHNOLOGY			MICROSOFT CORPORATION	136-137	-		10-1
10-611	NEWCOM	104NA7	159	QNX EXPLR2	18	50	RECRUITMENT	
- 0	FTIMADE		158	ONX SOFTWARE SYSTEMS LTD	183	*	MICROSOFT CORPORATION	18
S U	FTWARE		The same			E-1	MISCELLANICOLIS	
	-	-	262-263	VCOMMUNICATIONS	204	51	MISCELLANEOUS	
25	BUSINESS		54	OS/2			BYTE	17
23	CARDIFF SOFTWARE	165		IBM	15		BYTE	19
84	FINSON	170		IBM	43	*	BYTE BACKISSUES	8
08-609	LOTUS	16-17			1000	*	BYTE BACK ISSUES	21
			40	PROGRAMMING		*:	BYTE CUSTOMER SERVICE	21
06-607	LOTUS	83		LANGUAGES/TOOLS			BYTE EURODECK	6
	PROXIMA CORPORATION	169	731-732	ADONTEC GMBH	48IS 10		BYTE FIELD SALES	48153
	PROXIMA CORPORATION	171	138	BORLAND INTERNATIONAL	37	*	BYTE MOVING?	19
	PROXIMA CORPORATION	173		COPIA INTERNATIONAL LTD	22			23
76-177	PROXIMA CORPORATION	175	122	DUNNSYSTEMS	227		BYTE PUBL STATEMENT	
27	COMMUNICATIONS/		144	FAIRCOM CORPORATION	187		BYTE REPRINTS	7
							BYTE SUB MESSAGE	21
	NETWORKING	2350	221	GLOBETROTTERSOFTWAREING	149	*	BYTE WEB SITE	48153
24	ATTACHMATE CORP	87	710	GREYMATTERLTD	4815 32		BYTE WEB SITE	23
	DISTINCT CORPORATION	150	723-724	INNOVATIVE SOFTWARE	48IS 40	196	CETRA	17
601 268-271				DIRECTOR OF THE PERSON	404			393
68-271	FIRST SOURCE INT'L	210	202	INNOVUS MULTIMEDIA	131		MICROGRAFX	17
		210 226	202 179-180	IQ SOFTWARE	12-13			17
68-271 41-242	FIRST SOURCE INT'L	226	NEW CONTRACTOR			222	MICROGRAFX NRW	

EDITORIAL INDEX

For more information on any of the companies covered in articles, columns, or news stories in this issue, circle the appropriate inquiry number on the response card. Each page number refers to the first page of the article or section in which the company name appears.

INQUI	RY NO.	PAGE NO.	INQUI	RY NO.	PAGE NO.	INQU	RY NO.	PAGE NO.	INQUI	RY NO.	PAGE NO.
	A			Digital Equipment	59, 112, 129,		Madge Networks Europe	48IS 7		R	
1009	Access Software	185	1063	2010111	134, 139, 240	1065	MarketScape	26,54	1029	RadMedia	122
	Acer	48IS 25	1069	Digital Harbor	49	981	Mathcomp	48IS 33	977	Rhetorex Europe	48IS 33
	Acom	105		E		1031	Maximizer Technologies	240		S	
998	Advantech	48IS 33	985	Ematek Infomatik	48IS 33		McAfee	167		S&S International	167
1023	Aimtech	122		Envox	48IS 7	989	MCE Computer Peripher	ie 48IS 33	1016	SAG Electronics	112
1070	Alps Electric	50		F		1049	MCSI	240	1	The Santa Cruz Opera	tion 139
	AMD	89	997	First International Computer	48IS 25, 48IS 33	979	MegaSoft	48IS 33	1039	Sequel Technology	240
1034	American Data Acquisitio	n 240		Folio	26		Men and Mice	129	1041	Server Technology	240
996	APE Ptacek Engineering	48IS 33	1030	Fractal Design	240	1027	mFactory	122	1032	ServiceSoft	240
		4, 26, 101,	1030	-33		SAME	Micro Design Internationa			Sharp Electronics	26
		134, 151		Fujitsu	48IS 25		Micro Logic	185		Silicon Graphics	139
	Asustek Computer	48IS 25		G	NAME OF THE PARTY	(1)(4)(5) (2)(5)	TAME IN THE DISTRICT	240		Silicon Integrated Syst	
1025	Asymetrix	122		Gage Applied Scie		1040	Micronics Computers/ Orchid Technology	240		software.com	26
995	ATDI	48IS 33	1047	Gateway 2000	240		Microsoft 14, 26	, 134, 145	1022	Solid Oak Software	240
	ATML	48IS 17		Groupe Bull	139	988	miro Computer Products	48IS 33	-31		
1038	AutoGraph International	240		GVC	48IS 25		Mitel Telecom	48IS 7	1044	Strata	240
1054 1062	Axis Communications	240	991	H Hantz & Partner	48IS 33		Motorola	14, 26, 67		Sun Microsystems	14, 63, 79 105, 139
	D			Hewlett-Packard	112, 139,		N			Symantec	167
	BackWeb	26	1057	Tiewiett i dekard	240		NChannel International	105		T	
1040	Bluecurve	240	1055	Hitachi Computer I	Products 240		NetChannel	105		TCT-ThunderByte	167
986		48IS 33		1			Netscape	105	984	TechLog	48IS 33
300	Bradford University Software Services	4013 33		IBM	14, 105, 139,	1008	Nimantics	185	1058	Tecmar Technologies	240
	C				167, 248	1068	Novell	53	983	ToolShop	48IS 33
	Caere	26	1014	IBM Personal Com	puter 112		0		980	Toplevel Computing	48IS 33
1040	Cambridge Quality	240	992	ICP Vortex Computersystem	48IS 33	1060	Okidata	240		Toshiba	48IS 3
	Management		1004	Innovus	122		Olicom	48IS 17		Touchstone Software	167
	Canal +	48IS 3	1024			1059	Olympus Image Systems	240		U	
1004	Centura Software	177		Intel	14, 89, 167	990	Opti International	48IS 33	1051	U.S. Robotics	240
1037	Century Software	240		International Meta		1028	Oracle	105, 122		V	
	Cheyenne Software	167		lomega	184	1.0.00	Oxford Parallel	71	1067	Verilog	181
1064	Compaq Computer	240	976	Isoft	48IS 33			5.0	1050	Vivitar	240
1000	Computertechnik	48IS 33		J		1052	Pacific Data Products	240		VoiceBit	48IS 7
1026, 1035	Corel	122, 240	1046	JASC JetForm	240 26	1053	PhoNet	48IS 7		VSN Systemen	48IS 7
1045	Core Technology	240				1056	PixelVision	240		W	
	Creative Labs	185	993	KTT	48IS 33		Pointcast	26	1036	Wessex	240
	CyberMedia	185	000	i de la companya de l	7010 00	1015	Polywell Computers	112	982	Windmill Software	48IS 33
	Cyrix	26,89	004	Loughborouth	and 4010.00	1005	Powersoft	177		X	
	-	20,00	994	Loughborough Sou Images	and 48IS 33		Procom Technology	240	1017,	Xi Computer	112
1011	D Dell Computer	440	-	M		and the same of th			1018	The second secon	
1011	Dell Computer	112	1022	Macromedia	122	978	QBS Software	48IS 33			



PEAK PERFORMANCE IS THE NAME OF THE GAME

The name of the book to get you there is the

BYTE Guide to Optimizing Windows 95

Don't let Windows 95 run your life. With the BYTE Guide to Optimizing Windows 95, you're in control. Filled with fresh solutions and optimizing shortcuts, you'll find slick tips and expert advice on

- Installing Windows 95
- · The Internet
- Multimedia
- · Handling old Windows and DOS applications
- · Networking with Windows
- Troubleshooting...and much more

You'll also get the real scoop on hardware issues and third-party products. An ideal guide and handy reference, you'll turn to the BYTE Guide to Optimizing Windows 95 again and again as you power up Windows 95 to your standards.



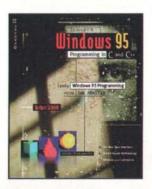
BYTE Guide to Optimizing Windows 95 by Lenny Bailes with Bermant, Menefee, and Heilborn \$29.95 USA ISBN: 0-07-882120-7



BYTE Guide to CD-ROM, Second Edition by Michael Nadeau Includes One CD-ROM Disc \$39.95 USA ISBN: 0-07-882104-5



BYTE Guide to OpenDoc by Joshua Susser & Andrew MacBride \$29.95 USA ISBN: 0-07-882118-5



Schildt's Windows 95 Programming in Cand C++ by Herbert Schildt \$29.95 USA ISBN: 0-07-882081-2



Schildt's Advanced Windows 95 Programming in C and C++ by Herbert Schildt \$29.95 USA ISBN: 0-07-882174-6

□SBORNE

http://www.osborne.com

CODE=SF36BYL

Available now at your local book and computer stores or call 1-800-822-8158 and use your American Express, VISA, Discover, or MasterCard.



AT NATIONWIDE STORES

BARNES & NOBLE BE BYTE/OSBORNE BOOKS ARE AVAILABLE AT THE FOLLOWING LOCATIONS

ALABAMA Madison Madison Books & Computers PH: 205-772-9250 FAX: 205-461-8076

ARIZONA Phoenix Computer Library PH-602-547-0331

CALIFORNIA Berkeley Cody's Books Inc. PH: 800-479-7744 in CA PH: 800-995-1180 Nationally

Citrus Heights Tower Books PH-916-961-7202

Cupertino Computer Literacy Bookshops PH: 408-973-9955

UCD Bookstore University of California PH: 916-752-2944

Los Angeles ASUCLA Students Store PH: 310-206-0763

Mountain View Printer's Inc. PH: 415-961-8500

Palo Alto Printer's Inc PH: 415-327-6500

Stanford Bookstore PH: 800-673-2348

Sacramento Tower Books 1600 Broadway PH: 916-444-6688

San Francisco Stacey's Professional Bookstore PH: 800-926-6511 EMAIL: staceysbk@aol.com

San Luis Obispo Earthling Bookshop PH: 805-543-7951 FAX: 805-543-8488

Santa Barbara Chaucer's Bookstore PH: 805-563-0010

UCSB Bookstore The University of California Santa Barbara PH: 805-893-2082

Sunnyvale Computer Literacy Bookshops PH: 408-730-9955

COLORADO Boulder University Book Center PH: 303-492-6411 FAX: 303-492-0421

Colorado Springs The Chinook Bookshop PH: 719-635-1195 FAX: 719-635-0792

Biblio Tek PH: 303-534-3460

United Techbook Co. PH-303-651-3184 FAX: 303-651-3405

CONNECTICUT New Haven Yale Co-Op PH: 800-ELI-YALE FAX: 203-772-3665

FLORIDA Gainesville Construction Bookstore PH: 904-378-9784 FAX: 904-378-2791

GEORGIA Atlanta Oxford Bookstore PH: 404-262-3333 FAX: 404-364-2729

HAWAII Honolulu University of Hawaii Bookstores PH: 808-956-4338 FAX: 808-956-4323

ILLINOIS Naperville Books and Bytes PH: 708-416-0102 FAX: 708-416-0375

MARYLAND College Park Maryland Book Exchange PH: 301-927-2510 FAX: 301-209-7118

Boston Charlesbank Bookshops PH: 617-236-7442 FAX: 617-236-7418

SoftPro Books PH: 617-273-2919 FAX: 617-273-2499 EMAIL: books@ softproeast.com

Cambridae Quantum Books PH: 617-494-5042 FAX: 617-577-7282 FMAII quanbook@world.std.com

Newton Highlands New England Mobile PH: 617-527-5817 FAX: 617-527-0113

MICHIGAN Western Michigan University Bookstore Western Michigan University PH: 616-387-3930 FAX: 616-387-3941

FAX: 603-643-5170

NEW JERSEY New Brunswick **Rutgers University** Bookstore PH: 908-246-8448

NEW MEXICO Albuquerque Page One, Inc. PH: 505-294-2026

NEW YORK Buffalo Village Green Bookstore PH: 716-884-1200 FAX: 716-884-3007

Huntington Books Revue PH: 516-271-1442 FAX: 516-271-5890

New York City Benjamin Books PH: 212-432-1103 FAX: 212-432-1104

Coliseum Bookstore PH: 212-757-8103 FAX: 212-489-0925

1 & R Computer World PH: 212-732-8600

McGraw-Hill Bookstore PH: 212-512-4100 FAX: 212-512-4105

New York University Computer Store PH: 212-998-4591

Rochester Campus Connections (RIT) PH:716-475-2504

Village Green Bookstore 1954 West Ridge Road PH: 716-723-1600 FAX: 716-723-1669

Village Green Bookstore 716 Monroe Avenue PH: 716-461-5380 FAX:716-461-9333

Syracuse Syracuse University Bookstore PH: 315-443-1654

OHIO Cleveland **Rusiness Outreach** PH: 216-348-1744 FAX: 216-348-0375

Readmore 217 Flanders PH: 419-225-5826 FAX: 419-725-5537

Readmore's Hallmark 3330 W. Elm Street PH: 419-225-5826

Youngstown Youngstown State University Bookstore PH: 216-742-3589 FAX: 216-742-3145

OREGON Beaverton Powell's Bookstore at Cascade Plaza PH: 503-643-3131 FAX: 503-641-1554

Book Mark PH-503-484-0512 FAX: 503-484-3130

Portland Powell's Technical Books PH: 503-228-3906 FAX: 503-228-0505

PENNSYLVANIA Doylestown Village Green Bookstore PH: 215-230-7610 FAX: 215-230-7615

The Erie Book Store PH: 800-252-3354 FAX: 814-456-2702

Philadelphia Bookstore of the University of Pennsylvania PH: 215-898-4900 FAX: 215-898-6997

Pittsburgh Book Center University of Pittsburgh PH: 412-648-2321 FAX: 412-648-1902

Paperback Booksmith PH-717-346-9162

RHODE ISLAND Providence Brown Bookstore PH: 401-863-3168 FAX: 401-863-2233 Taylor's Technical Books PH: 817-548-TECH

MEDIAPLAY

MICROCENTER

SOFTWARE, ETC.

SUPERCROWN

TAYLORS

WALDENBOOKS

Austin University Co-Op PH: 512-476-7211

Taylor's Technical Books PH: 214-239-TECH

Houston Brown Book Shop PH-713-652-3937 FAX: 713-652-1914

VIRGINIA Blacksburg University Bookstore, Virginia Tech PH: 703-231-5991 FAX: 703-231-3410

Vienna Computer Literacy Bookshops PH: 703-734-7771 sales@tc.clbooks.com

WASHINGTON Bellevue University Bookstore PH: 206-646-3300 FAX: 206-646-3340

Pullman Students Book Corporation PH: 509-332-2537 FAX: 509-332-8239

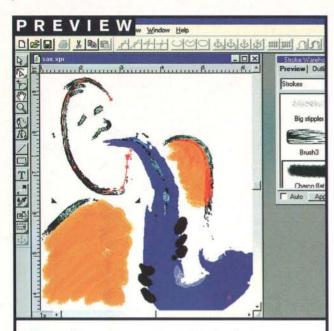
Tower Books PH: 206-283-6333 FAX: 206-285-2188

Tower Books PH: 206-473-3362 FAX: 206-473-9141

WISCONSIN Madison University Bookstore PH-608-257-3784 FAX: 608-257-9479

Milwaukee University of Wisconsin Milwaukee PH: 414-229-4201 FAX: 414-229-6194

What's New



Expression

\$449

Circle 1030 on Inquiry Card.

Fractal Design Corp.

Aptos, CA (800) 846-0111 (408) 688-5300 http://www.fractal.com

Mr. Natural Does Vector Graphics

magine van Gogh doing technical illustrations: chip schematics done with thick dabs of yellow paint; network diagrams that look like fields of wheat. Not that you'd want impressionistic schematics, but this should give you an idea of the kind of output you can create with Expression, Fractal Design's new drawing program.

If you've worked with other vector packages, you know that to draw, you put down a path. Expression's innovation, called "skeletal strokes," lets you easily change the attributes of a path (which Fractal Design calls a "stroke"), but it also lets you apply any vector picture to a path. The best part is working with vectors in a way that's close to working with traditional art tools.

Expression's toolbox includes line- and shape-drawing tools, node tools, a freehand brush, and color gradients and fills. The Windows 95 beta version that I used delivered snappy performance without making me wait several seconds for the lines I drew to appear on-screen. I used Expression with a Wacom pressure-sensitive tablet (the ArtZ II), and the combination worked like a charm.

Expression can handle most vector formats and can save files in these formats, as well as export in bit-map formats. If I had to buy my first illustration program now, I'd buy Expression. It goes beyond the standard packages, and it has that natural feel. - Dennis Barker

Business

Download Sales Leads from the Internet

You can access, SEARCH, AND DOWNLOAD contact information on 10 million North American businesses directly into Maximizer Enterprise 3.0is (US\$660 per seat) via the Internet and MultiActive Data's MultiActive Eagle on-line database. The product combines a contact manager, an application that automatically synchronizes field and home-office databases, and a translator that enables you to read and write Maximizer data from ODBC-compliant applications.



Contact: Maximizer Technologies, Inc., Vancouver, British Columbia, Canada, (800) 804-6299 or (604) 601-8000; http://www.maximizer.com.
Circle 1031 on Inquiry Card.

Self-Service Customer Support

Now organizations can provide guided, self-service customer support using the Web or corporate intranets. The Knowledge Builder development environment (\$5000 per development-system license) integrates several problem-resolution methodologies, such as natural-language retrieval, case-based rea-

soning, decision trees, and cause/ effect models, into an object-oriented development environment used by the Web Advisor application. Web Advisor (\$1500 per concurrent user session) guides users through dialog boxes to solve their problems; it also records customer interaction.

Contact: ServiceSoft Corp., Needham, MA, (800) 737-8738 or (617) 449-0049; http://www.servicesoft.com. Circle 1032 on Inquiry Card.

Communications

Advanced E-Mail Processing

DESIGNED FOR WINDOWS 95 AND NT. Re:Ply (\$59.95) checks for and downloads e-mail from multiple accounts; generates responses to e-mail according to your criteria; maintains a library of responses or letters that it can automatically plug in; and maintains mailing lists. You can send and receive encrypted e-mail to and from other Re:Ply users; instruct the program to automatically return unwanted e-mail; forward and redirect messages; and send MIME and UUE attachments. Contact: Solid Oak Software, Inc., Santa Barbara, CA, (800) 388-2761 or (805) 892-2550; http://www.solidoak.com. Circle 1033 on Inquiry Card.

Data Acquisition

Windows Data-Acquisition Software

WITH WINVIEW (\$99), YOU CAN ACQUIRE, display, and store data from data-

For our Previews, we take a look at Fractal Design's drawing package, Expression, and Gateway's big-screen notebook, the Solo 2100 S5-120.

acquisition boards. The program can display collected data in engineering units, including volts, degrees, and microstrain; display inputs in one graph or in separate graphs per channel; provide selectable x-axis settings for samples, seconds, minutes, hours, or days; and stream to disk at up to 333 kHz. Contact: American Data Acquisition Corp., Woburn, MA, (800) 648-6589 or (617) 935-3200; http://www.adac.com.

Circle 1034 on Inquiry Card.

Macintosh

Graphics and Word Processing Solution

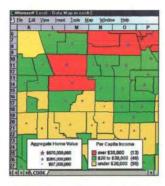
THE CORELDRAW 6 SUITE FOR POWER Macintosh (US\$595) includes CorelDraw 6, WordPerfect 3.5, CorelDream 3D 6, Corel Texture 6, Corel Artisan 6, Corel Multimedia Manager 6, CorelTrace 6, Master-Juggler 2.0 Pro, and CorelChart 6. It offers more than 25,000 clip-art images, 1000 high-resolution photos, 1000 Type 1 fonts, and 700 True-Type fonts.

Contact: Corel Corp., Ottawa, Ontario, Canada, (800) 772-6735 or (613) 728-3733; http://www.corel.com. Circle 1035 on Inquiry Card.

Mapping

Mapping in Excel 95

A MAPPING ADD-IN FOR MICROSOFT Excel 95 and Microsoft Office 95, the FirstMap CD-ROM (\$69) includes boundary maps and data for counties, ZIP codes, and census tracts in



the U.S. The package also includes U.S. census information, such as age, gender, race, household, income, employment, and industry. In Excel, you can use FirstMap to create maps of your sales, potential earnings, and competition, from a national level to a neighborhood surrounding a specific store or outlet, and print them out.

Contact: Wessex, Inc., Winnetka, IL, (800) 892-6906 or (708) 501-3662; http://www.wessex.com.

Circle 1036 on Inquiry Card.

Networking

A Client/Server Intranet Suite

To GIVE DESKTOP PC USERS SHARED ACCESS to applications, information, and peripherals located on a server or on another workstation, Plus[NFS] (single user, \$199; multiple-license packages, from \$179 per user) of-



fers the TinyTerm terminal-emulation utility, which allows desktop connections to popular Unix applications; FTP file transfers; an email and newsreader client; a Web browser; TCP/IP file and printer sharing; and client/server and peerto-peer networking capabilities using TCP/IP.

Contact: Century Software, Inc., Salt Lake City, UT, (800) 877-3088 or (801) 268-3088; http://www.censoft.com.

Circle 1037 on Inquiry Card.

Advanced CD-ROM Networking

WITH SCSI EXPRESS 2.0 FOR WINDOWS NT (\$1995 to \$3995, depending on device support), you can use NT's performance monitoring to choose optimal configurations for networked CD-ROM drives. The program can map multiple CD-ROMs as a single network share to bypass the 23-drive-letter limitation; it also enables users to share a CD-ROM across multiple groups. The Autoshare feature provides automatic sharing of CDs.

Contact: Micro Design International, Inc., Winter Park, FL, (800) 228-0891 or (407) 677-8333; http://www.mdi.com.

Circle 1043 on Inquiry Card.

Unix

Scanning Software for Unix

Now UNIX USERS HAVE A SET OF TOOLS for scanning and working with scanned images. EasyCopy/Scan (single-user license, \$695) lets you prescan a page in low resolution, display the prescan, and modify it

before the final scan. You can set the resolution to match a given file's size or an image's dimensions, or you can impose a maximum file size on the available resolution.

Contact: AutoGraph

International, Inc., San Jose,
CA, (408) 436-7227;

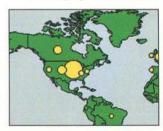
http://www.augrin.com.

Circle 1038 on Inquiry Card.

The Web

Web-Server Log-File Analysis

WITH WEB TRACKER 1.0 (\$495), YOU CAN analyze access patterns for your Website. The program, for Windows



3.x, 95, and NT, supports exploratory analysis through fast drill-down and a variety of trending and geographical charting functions. Contact: Cambridge Quality Management, Inc., San Francisco, CA, (415) 750-1327; http://www.CQMInc.com/.
Circle 1040 on Inquiry Card.

Monitor Internet Usage

COMPANIES CAN MANAGE AND REPORT their Internet, intranet, and on-line usage with Sequel Net Access Manager 1.0 (one to 49 users, US\$89 per user). You can have the program report at the group level; activate or deactivate logging or monitor-

ing functions; and grant or deny site access. The program enables you to monitor Internet activity based on protocols such as HTTP. NTTP, FTP, and SMTP; internal Web servers; and centrally accessed online services.

Contact: Sequel Technology Corp., Willowdale, Ontario, Canada, (800) 881-2465 or (416) 756-3551; http://www.sequeltech.com. Circle 1039 on Inquiry Card.

Windows NT

Analyze Windows NT Client/Server Systems

DYNAMEASURE (FOUNDATION LICENSE, \$29,995) puts controlled stress on Windows NT client/server systems and then measures the effect of the stress. Test specifications include OLTP reads, writes, and mixed read/

write tests, including versions that use BLOBs.

Contact: Bluecurve, Inc., Oakland, CA, (510) 267-1500; http://www.bluecurve.com.

Circle 1042 on Inquiry Card.

Orderly Shutdown for Windows NT Servers

DESIGNED FOR UNATTENDED REMOTE WINdows NT servers. Sentry ShutDown Remote Power Manager provides a multilevel-password interface for power management of missioncritical NT servers and workstations. The product comes in two versions, supporting out-of-band modem and RS-232 communications (\$669.95 and \$719.95, respectively); an optional model supports an in-band telnet TCP/IP session. Contact: Server Technology, Inc., Sunnyvale, CA, (800) 835-1515 or (408) 745-0300; http://www.servertech.com. Circle 1041 on Inquiry Card.

HARDWARE

Add-Ins

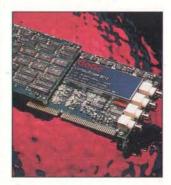
2-D and 3-D Graphics and Video Acceleration

BASED ON THE S3 VIRGE 64-BIT GRAPHics and video accelerator chip, the Fahrenheit Video 3D package (with 2 MB of memory, \$239) comes in a 2-MB EDO DRAM configuration for the PCI bus and supports screen resolutions up to 1600 by 1200 pixels, true color depths, and refresh rates up to 160 Hz. Digital video acceleration and SuperZoom video scaling provide full-screen, full-motion playback at resolutions up to 1024 by 768 pixels.

Contact: Micronics Computers, Inc./Orchid Technology, Fremont, CA, (800) 577-0977 or (510) 651-2300; http://www.orchid.com. Circle 1048 on Inquiry Card.

12-bit A/D System

THE COMPUSCOPE 8012 (\$7995) IS AN IBM AT-compatible ISA-bus card capable of performing 12-bit A/D conversion at real-time sampling rates up to 100 MSPS in single-channel mode and 50 MSPS in dualchannel mode, with a bandwidth of 40 MHz. The card can store up to 4 million samples in its on-board memory, and you can stack data from successive triggers. Contact: Gage Applied Sciences, Inc., South Burlington, VT, (800) 567-4243 or (514) 337-6893; http://www.gage-applied.com.



Circle 1052 on Inquiry Card.

166-MHz 586 ISA/PCI CPU Board

DESIGNED FOR INDUSTRIAL APPLICATIONS. the IPV-586 ISA/PCI Pentium board (\$925) comes with two serial ports. a bidirectional parallel port, a dual floppy drive port, a dual EIDE hard drive port, a VGA accelerator interface with feature connector, a PS/2 keyboard port, a PS/2 mouse port, an on-board speaker, a watchdog timer, and up to 128 MB of DRAM. Contact: MCSI, Vista, CA, (619) 598-2177;

mcsi@mcsi1.com.

Circle 1049 on Inquiry Card.

Communications

ISDN/Analog Multiport System

THE MP/8-I MODEM AND MP/16-I MOdem integrate U.S. Robotics' V.34/ Everything modem technology with ISDN terminal adapters. Be-



cause each port has the ability to automatically detect the remote device type, you can send or receive analog and ISDN calls. The MP/8-I (\$6495) includes four ISDN terminal-adapter interfaces, supporting eight B-channels/ports. The MP/ 16-I (\$10,995) includes eight ISDN terminal adapters, supporting 16 B-channels/ports.

Contact: U.S. Robotics, Skokie, IL, (800) 877-2677 or (847) 982-5010; http:// www.usr.com.

Circle 1051 on Inquiry Card.

Motion-Picture Phone

THE VIVITAR MPP-2 (\$249.95), A COLor video phone system, transmits sight and sound over standard telephone lines using a 486-based mul-

Software Updates

StudioPro 2.0 for Power Macintosh, a modeling, rendering, and animation package, adds in-context modelers; on-the-fly animation; a deformation tool; spline and polygonal-based modeling; a project window; an Environment Palette; a scan-line renderer; and camera controls, \$1495.

Contact: Strata, Inc., St. George, UT, (800) 678-7282 or (801) 628-5218; http://www.strata3d.com.

Circle 1044 on Inquiry Card.

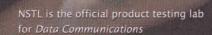
A computerized in/out board and messaging package for LANs and WANs, Who's Where 2.0 for Windows offers automated status login upon start-up, automated status log-out upon shutdown, group messaging, TCP/IP support, reporting capabilities, and integration with e-mail. Stand-alone version, from \$50; 10-user license, \$395; 25-user license, \$835; 50-user license, \$1295.

Contact: Core Technology Corp., Lansing, MI, (800) 338-2117 or (517) 627-1521; http://www.ctc-core.com. Circle 1045 on Inquiry Card.

An image editor for Windows 95 and NT, Paint Shop Pro 4.0 provides an enhanced paintbrush tool; special effects; support for 33 formats; an enhanced retouch tool; a selections feature, which allows you to adjust overall opacity, designate a transparent color, or feather a selected area; an Image Arithmetic feature; and an integrated image browser. \$69.

Contact: JASC, Inc., Eden Prairie, MN, (800) 622-2793 or (612) 930-9800; http://www.jasc.com.

Circle 1046 on Inquiry Card.



Convince your customers that your product won't their network traffic

with NSTL

You need to know how to keep the information flowing safely, costeffectively, and quickly. NSTL can help you break the networking bottlenecks.

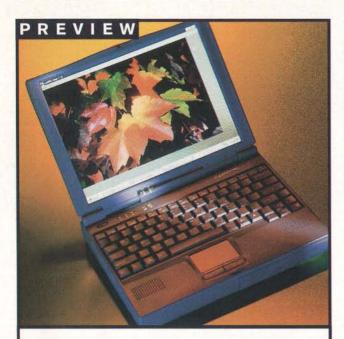
NSTL gives you the answers you need to assure potential customers of your product's performance. We'll work with you to design a cost-effective testing program to give you the answers to your customers' network performance questions.

Contact us early in your product development lifecycle to learn how NSTL can help you avoid costly and embarrassing mistakes.

Call 1-610-941-9600 to request a brochure or a proposal detailing the scope, pricing, and scheduling of confidential network services.

http://www.nstl.com NSTL

A Division of The McGraw-Hill Compan



Gateway 2100 \$5-120 \$3799 as reviewed

Circle 1047 on Inquiry Card.

Gateway 2000

North Sioux City, SD (800) 846-2000 (605) 232-2000 http://www.gw2k.com

Gateway's Big-Screen Notebook Debut

The Solo 2100 series of multimedia notebooks blends raw power and good looks into a 7-pound package that's a perfect fit for on-the-go computing. Sporting a rich set of standard features and available options, the Solo 2100 affords Gateway the hope of garnering a bigger share of the portables market.

Gateway lets you configure your Solo with a wide array of options: a 100-, 120-, or 133-MHz Pentium; a 256-KB cache; up to 40 MB of EDO RAM; and a 540-MB to 1.3-GB hard drive. Multimedia support includes a six-speed CD-ROM, which you can pop out to insert a floppy drive module as needed; 16-bit sound; and speakers. I found the sound quality from the Solo 2100 S5-120's tiny speakers adequate for Windows' sounds and business audio.

The Solo's 12.1-inch active-matrix color display (see the photo), which is powered by a 32-bit accelerator with 1 MB of EDO video memory, rivals a 14-inch desktop monitor. When configured for a resolution of 800 by 600 pixels and 64,000 colors, images and text were sharp and clear.

Fitting a keyboard and a pointing device onto a notebook can create problems, and the Solo 2100 S5-120 is not exempt. The keys in the top row—including the Ins, Del, Home, End, and function keys—are smaller than normal, making them difficult to find without peeking. And the addition of four new keys to the bottom row shrinks the space bar to a diminutive 3-inch target. The Synaptics touchpad is a joy to operate, but I soon found that its position, directly below the tiny space bar, left me no room to rest my thumbs, which led to a spate of accidental pointing and clicking.

Although it suffers from the same drawback as its peers—cramming a lot of computer into a small package—good looks and versatility make the Solo 2100 S5-120 an attractive choice for mobile computing.

-Robert L. Hummel



timedia PC and a 14.4-Kbps modem. The plug-and-play system comes with a golf-ball-size, prefocused camera that mounts on top of your monitor and provides refresh rates up to 10 fps. The package includes PictureWorks' PhotoEnhancer software and Smith Micro's VideoLink videoconferencing software.

Contact: Vivitar Corp., Newbury Park, CA, (805) 498-7008. Circle 1050 on Inquiry Card.

Networking

External and Pocket Print Servers

THE DIRECTNET EX II EXTERNAL PRINT server and the DirectNet PEPS2 Plus pocket prints erver facilitate access to printer locations on NetWare, TCP/IP, and AppleTalk networks. The EX II (\$399) includes two highspeed bidirectional parallel data ports; the PEPS2 Plus has one. Both units support Novell's 4.x Network



Directory Service and have 10Base-2 and 10Base-T connectors.

Contact: Pacific Data Products,
San Diego, CA, (800) 7377117 or (619) 552-0880;
http://www.pacdata.com.

Circle 1053 on Inquiry Card.

Network-Ready Color Camera

DESIGNED FOR INTERNET AND INTRANET applications, the Axis NetEye 200 (\$1299) is a self-contained, palm-

size camera that attaches directly to a 10-MB Ethernet network. You can use the camera as a replacement for closed-circuit video or a PC with a frame-grabber.

Contact: Axis Communications, Inc., Woburn,

MA, (800) 444-2947 or (617)
938-1188; http://www.axisinc.com.

Circle 1054 on Inquiry Card.

Workgroup Switching

FOUR FAST ETHERNET DEVICES, THE HI-Speed 150 series (from \$7595) provides up to 32 Ethernet connec-



tions, as many as 16 Fast Ethernet connections, and the ability to let users interchange FDDI, ATM, and WAN uplinks within the same unit. All Fast Ethernet ports support automatic switchable operation at 10 or 100 Mbps.

Contact: Hitachi Computer Products, Inc., Santa Clara, CA, (800) 448-2244 or (408) 986-9770.

Circle 1055 on Inquiry Card.

Peripherals

16-inch Flat-Panel Monitor

THE PV116SX (UNDER \$10,000) IS AN active-matrix color LCD flat-panel monitor that measures about 3 inches deep and has a resolution of 1280 by 1024 pixels and a diagonal viewing area of 16.1 inches. The monitor provides a 2-million-color palette, on-screen menu controls, and options for finger-touch



The Definitive Reference Source!



5 Years of BYTE 1991-1995 Call 1-800-924-662

PLUS: Quarterly Updates with Every Issue in 1996



It's all at your fingertipsemerging trends, comprehensive world-wide industry

analysis, multiplatform coverage of all the technologies, in-depth testing and product evaluations, advice, tips expert opinions, and much more! It's ideal for anyone who's evaluating the significance of new technologies . . . doing

research . . . making complex multiplatform purchasing decisions . . . developing the next generation hardware or software products . . . preparing strategic corporate plans.

It's Comprehensive . . . Time Saving . . . and Easy to Use! It's all in BYTE on CD-ROM

Order Today!

Order Now!

Toll-free national numbers:

080071635 Belgium Germany 0130826112 U.K. 0800973017 Italy 167876155 05916088 France Netherlands 05916088 Switzerland 1557257

80017728 Denmark Sweden 020791136 900933539 Spain Other

International 091-752792 United States 1-800-924-6621 Fax: 609-426-5434

Yes! I want the power & convenience of BYTE on CD-ROM

ticles & Full Text Database

Send me Byte on CD-ROM PLUS! Full text from 1991-1995 issues of BYTE plus quarterly CD-ROM updates with full text and colorful graphics for all the 1996 issues of BYTE for just \$54.95.

Send me BYTE on CD-ROM. Full text from 1991-1995 issues of BYTE —more than 60 issues for only \$39.95.

Charge my:

MasterCard
VISA
Amex
Check enclosed (make checks payable to BYTE magazine, US funds only)

Card#

Exp. Date Name

Address City Zip/Postal Code

Mail to: BYTE on CD-ROM, P.O. Box 526, Hightstown, NJ 08520 P.O. Box 85, Galway, Ireland

Canadian and U.S. orders, please add \$2.95 for shipping and handling, and state sales tax where applicable. (Canadian orders add appropriate GST.) Outside North America, add \$5.00 for air mail delivery. Allow 6-8 weeks for delivery. A Division of the McGraw-Hill Companies

CDBY096

B. Y. O. I. S. P.

(Bring Your Own Internet Service Provider)

Log into BIX and you'll find people like yourself. People who are glad to lend a helping hand when someone asks a question. People who listen to what you have to say. People who know about things that will surprise you.

Now BIX is available at a price never before seen online.

If you already have Internet access, telnet to BIX

Flat Rate: \$6.95/mo \$14.97/3mo \$24.97/6mo \$34.97/year

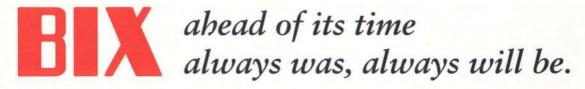
This plan allows unlimited use of both our text-based services and

Web services available only to BIX members.

If you need Internet access, BIX offers a Flat Rate plan at prices ranging from \$23.95/month (down to as low as \$16.95/month if you pay by the year) including nationwide access at speeds up to 28.8kbps or X.25 access at speeds up to 14.4kbps, and a pay-as-you-go plan for \$12.95/month for six hours of access plus \$2/hour thereafter.

Complete details are available from our e-mail auto-responder at info@bix.com or by visiting the BIX Web Site (see below).

To sign up for BIX, dial (800) 695-4882 or dial (617) 492-8300, enter *bix* when prompted and enter *bix.rd* at the Name? prompt. A step by step procedure will get you logged into BIX. The same procedure works if you telnet to bix.com or x25.bix.com, and you can also sign up on our Web Site.



Visit us on the Web at http://www.bix.com/

and pen-input versions.

Contact: PixelVision, Acton,
MA, (508) 264-9443;

http://www.pixelvision.com.

Circle 1056 on Inquiry Card.

Low-Cost Color Ink-Jet Printer

THE DESKJET 400 (ABOUT \$199) OFFERS 600- by 300-dpi black printing, Hewlett-Packard's Resolution Enhancement technology for crisp text and smooth edges, and 300by 300-dpi color printing at a rate of 3 ppm. Plug-and-play-ready for Windows 95, the printer includes a 50-sheet paper tray and a manual-feed path for printing labels, postcards, standard-size envelopes, and nonstandard paper sizes. Contact: Hewlett-Packard Co., Santa Clara, CA, (800) 752-0900 or call local Hewlett-Packard dealer; http:// www.hp.com. Circle 1057 on Inquiry Card.

Universal QIC Drive

FEATURING 2.5-GB LINEAR TECHNOLOGY, the Wangtek 52000 Universal QIC drive (about \$475) offers a standard SCSI-2 connection with a sustained data transfer rate of 17 MB per minute. Linear recording and read-after-write verification ensure that information can be easily and accurately restored in the event of data-loss incidents.

Contact: Tecmar Technologies, Inc., Longmont, CO, (800) 422-2587 or (303) 682-3700; http://www.tecmar.com.

Circle 1058 on Inquiry Card.

Optical Storage on 230-MB Cartridges

A PALMTOP-SIZE OPTICAL-STORAGE DEVICE for Mac, Windows, and DOS computers, the SYS.230 Personal Stor-



age System (about \$359) can store images downloaded from the Internet or from digital cameras; back up and archive files and databases; store music; and transport your work between office and home. The SYS.230 transfers data at up to 2.4 MBps and offers a seek time of less than 17 ms.

Contact: Olympus Image Systems, Inc., Melville, NY, (800) 347-4027 or (516) 844-5000; http://www .olympusamerica.com. Circle 1059 on Inquiry Card.

Dot-Matrix Printers for Multipart Forms

Now you CAN PRINT ON MULTIPART FORMS and on stock measuring up to twice the thickness that standard dot-



matrix printers are able to handle. The Microline 320/321 Turbo (from \$499) includes Courier and Gothic fonts, plus NLQ, utility, high-speed draft, and super-speed draft, as well as eight scalable bar codes. The Windows 95–compatible printer has 64 KB of RAM and a 28–KB receive buffer.

Contact: Okidata, Mount Laurel, NJ, (800) 654-3282 or (609) 235-2600; http:// www.okidata.com. Circle 1060 on Inquiry Card.

Servers

CD-ROM Servers with Eight-Speed Drives

PROCOM'S CD TOWER-RAX (CADDY, \$56,928; tray, \$56,008) rack-enclosed CD-ROM servers can contain up to 56 caddy- or tray-based CD-ROM drives to provide up to 36.4 GB of data over a network. The servers deliver a sustained data



transfer rate of 1200 KBps and an average seek time of 115 ms. The CD Tower-Rax servers offer one to eight racks of seven drives; a smart board that maps each seven-drive rack to one SCSI ID; 100- or 166-MHz Pentium CPUs; 4 to 128 MB of SIMMs; eight CD-ROM management software packages; two SCSI host adapters; a VGA monitor; a keyboard; a mouse; and a hard drive.

Contact: Procom Technology, Inc., Irvine, CA, (800) 800-8600 ext. 414 or (714) 852-1000; http://www .procom.com.

Circle 1061 on Inquiry Card.

Network CD-ROM Servers

THE AXIS STORPOINT CD-ROM SERVERS, for Ethernet and Token Ring LANs, allow users in NetWare, Windows



NT/95, Windows for Workgroups, OS/2, Unix, and Web/intranet environments to access and share CD-ROMs and CD-ROM-based information over a network. The servers (from \$799) have the ability to simultaneously connect seven drives directly and up to 49 drives through LUN expansion.

Contact: Axis Communications, Inc., Woburn,
MA, (800) 444-2947 or (617)
938-1188; http://www.axisinc.com.

Circle 1062 on Inquiry Card.

Systems

Alpha 21164 Desktop Workstation

The AlphaStation 500/500 (\$54,660) supports Digital Unix, Windows NT, and OpenVMS. The workstation comes with 128 to 512 MB of memory; 2 MB of cache; 4 MB of texture memory; a 256-bit-wide memory bus; a PowerStorm 4D60T graphics adapter; a 2-GB hard drive; a 21-inch color monitor; a floppy drive; a quad-speed CD-ROM drive; five storage slots; four PCI bays; one 64-bit PCI expansion slot; twisted-pair and thin-wire Ethernet; and stereo-quality audio.

Contact: Digital Equipment Corp., Maynard, MA, (800) 344-4825 or call local Digital dealer; http://www .workstations.digital.com. Circle 1063 on Inquiry Card.

Multimedia PC

DESIGNED FOR MULTIMEDIA AND GAMING enthusiasts, the Presario 8000 Series (from \$2499, without a monitor) delivers PowerVR Arcade 3-D Graphics technology, featuring 6 MB of graphics memory and supporting up to 1 million large polygons per second; the InterWave sound system; and JBL Pro speakers, with a separate tweeter and full elliptical driver. A 33.6-Kbps Talk and Send DSVD modem provides Internet access over standard telephone lines. Other features include up-to-200-MHz Pentium processors; 24 to 32 MB of RAM; 512 KB of pipeline burst cache; and up-to-3.8-GB hard drives.



Contact: Compaq Computer Corp., Houston, TX, (800) 345-1518 or (713) 514-0484; http://www.compaq.com. Circle 1064 on Inquiry Card.

codetak

Visual Age for BASIC...Sort Of

IBM's Visual Age for BASIC looks like VB but adds OOP underneath.

By Rick Grehan

egular readers of this column may recall that in October 1995, I examined IBM's Visual Age for C++ on OS/2. Since then, IBM has extended the Visual Age product line to new OSes and languages. Visual Age for Smalltalk existed before the C++ variant. Visual Age for C++ is now available on Windows NT. IBM has also released Visual Age for COBOL. The most recent addition to the product line, Visual Age for BASIC (the product had a code name of Bart), however, more closely resembles Microsoft's Visual Basic than it does any of the other Visual Age products.

The Visual Age paradigm encourages construction by *parts* (in IBM lingo, a part is a visual or nonvisual component). The developer specifies the interactions of parts and, therefore, the execution behavior of the application by wiring together parts and defining activities associated with those connections.

For example, suppose you're building a data-input screen that consists of a listbox and a "clear" button. You want the clear button to erase whatever is in the listbox. Using the Visual Age construction methodology, you connect the button to the box-the Visual Age integrated development environment (IDE) will draw a line from button to box-and associate an event with that connection. In this case, you tell the system that a click event on the button triggers the erase() method of the listbox. This construction technique applies to nonvisual objects as well as the visual ones I used in the example.

Thus, when Visual Age for BASIC appeared (I examined a late beta version running under NT, but IBM says it will also release versions for OS/2 and AIX), I was eager to explore the Visual Age interface elements of the package and investigate

how IBM had whipped BASIC into objectoriented shape. Unfortunately, although I was looking forward more to the former aspect—the program's Visual Ageness—it was the latter aspect—the objectoriented features—that proved to be more interesting.

Bluntly put, it appears that the sole reason the package carries the Visual Age prefix is that IBM chose to call it Visual Age for BASIC. Were Visual Age for BASIC and Visual Age for C++ presented to me as siblings, I'd suggest that the presenter go back and check the parentage. Visual Age for BASIC's interface is obviously descended from Visual Basic.

Missing from all the documentation (available in the beta version only in online format) is any mention of the word part. Instead, the documentation speaks of components. Though some might suggest that I'm nit-picking, I can't shake the feeling that there's some sort of capitulation going on here.

Applications construction under Visual Age for BASIC proceeds along lines similar to those of Visual Basic and draws from a similar cast of characters. Forms

WHERE TO FIND

IBM http://www.software.ibm.com /ad/vabasic/

are the fundamental window units, and you populate them with controls by selecting from a toolbar. Once a control is situated, you can summon an associated properties window and a code-editing window. However, if you are familiar with Visual Basic, you've seen all this before.

On a more positive note, Visual Age for BASIC does a good job of clothing BASIC in object-oriented garb. It supports class hierarchies and multiple inheritance

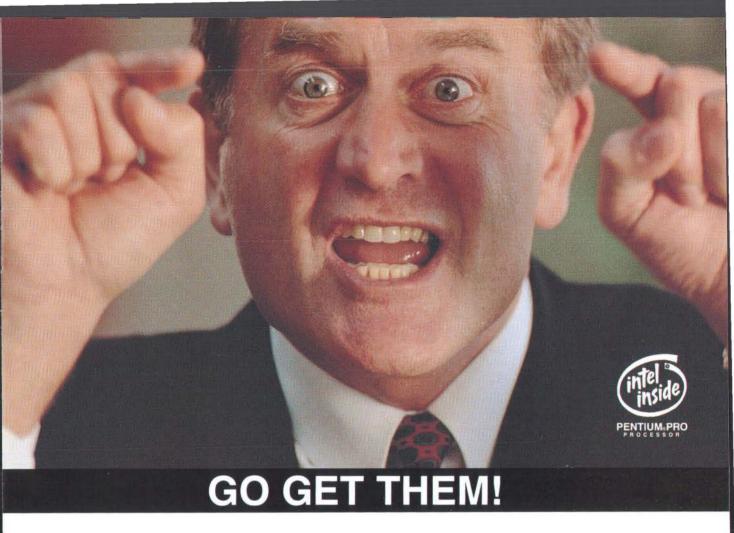


as well as inheritance-based polymorphism. Also, Visual Age for BASIC can digest System Object Model (SOM) objects as well as OLE objects.

Finally, if your design work tends toward client/server database development using DB2 on NT, Visual Age for BASIC recognizes a separate stored procedure project, which allows you to build and test stored procedures much as you would build BASIC applications. (Admittedly, I did not experiment with that portion of the package.)

Visual Age for BASIC's first release amounts to a somewhat improved Visual Basic. (If you've been wondering, from what I've seen so far, the syntax differences between Visual Age for BASIC and Visual Basic are so minor that porting programs written for the latter to the former should be—and I stress the words should be—painless.) IBM representatives have suggested that future versions might incorporate more of the original Visual Age environment. I'd like to see that.

Rick Grehan is a senior technical editor for BYTE reviews and the coauthor of The Client/Server Toolkit. You can reach him by sending e-mail to rick g@bix.com.



Yes, you can. NOW, you can excel, superperform and meet all your client's needs or your very own in a flash. Power on MITAC's workstation 'TD6600N' with an Intel Pentium® Pro processor and delve into the thrill of speed and superpower.

Running at 200MHz, and supporting upto 256MB of DRAM, the TD6600N is the ideal workstation for memory-hungry and speed-starved operations such as CAD, intense DTP, graphics, design and other heavy-duty 32-bit applications.

Expandability. Supporting both the USB and ATX protocols, as well as 4 PCI and 4 ISA slots, MITAC's TD6600N offers more function integration, multiple connections on a single bus, and great flexibility. The TD6600N also supports upto 3 hard disks concurrently, giving you more than 6GB in one desktop machine!

To crown its claim of the ultimate workstation, MITAC's TD6600N also comes with crystal audio CODEC [optional], 16-bit stereo, Soundblaster-compatible full duplex audio as well as 3D S3 Virge graphics capabilities and supports fax-IrDA and Consumer Infrared interfaces. MITAC's brawny workstation is shipped preloaded with the powerful Windows NT ready to run.

Now reliability. MITAC's TD6600N not only supports error checking and correction [ECC] but you can rest assured of the MITAC value-added quality, reliability and stability that many in the PC industry have come to rely on for so many years now.

Longing for real power, speed and hyperformance? Ask for your MITAC TD6600N today.





■ MITAC INTERNATIONAL CORP. Lin Kuo Office -- Tel:886(3)3289000 Fax:886(3)3280928

■ E-mail: market@smtplink.mic.com.tw
■ (URL): http://mitac.mic.com.tw

The Intel Inside Logo and Pentium are registered trademarks and the Pentium Processor Logo and the Pentium Pro Processor Logo are trademarks of Intel Corporation.

Finish Out Your Rack with a Magnum Commander

- Control up to 96 file servers with just 1 keyboard, monitor and mouse
- Supports all 100% IBM compatible PCs and PS/2 or serial mice; integral Sun and optional Macintosh support available
- 3.5" unit is designed for 19, 23, and 24" rack applications
- Each unit controls up to 16 file servers; cascade up to 6 units
- Control all computers locally, remotely, or both
- AutoBoot[™] feature boots all computers without user intervention
- Push-button and keyboard controlled scanning standard
- Rear peripheral access available





COMMANDER"

Cybex Computer Products Corporation
4912 Research Drive Huntsville, AL 35805 USA
(205) 430-4000 (205) 430-4030 fax
http://www.cybex.com/



